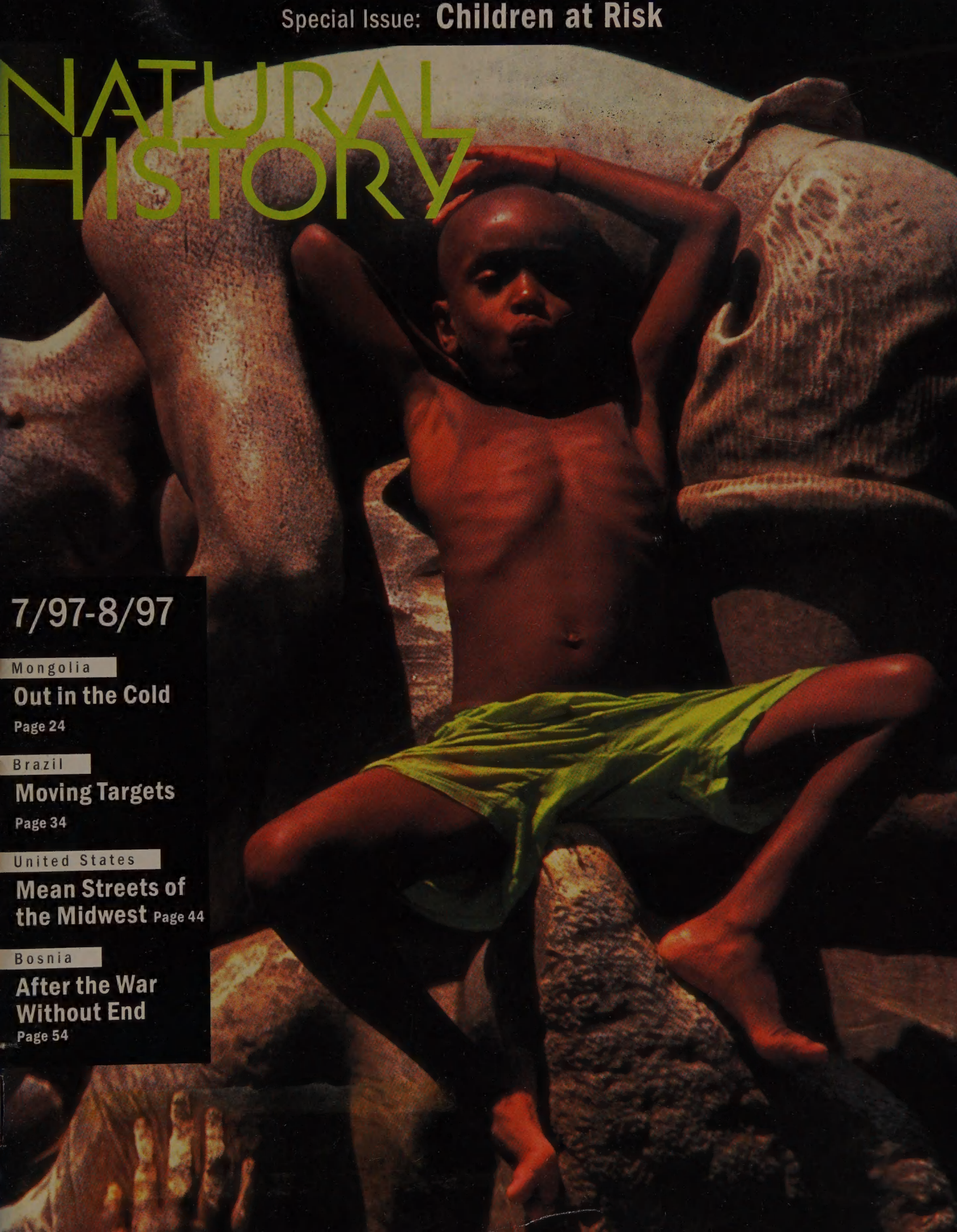
Special Issue: **Children at Risk**

NATURAL HISTORY



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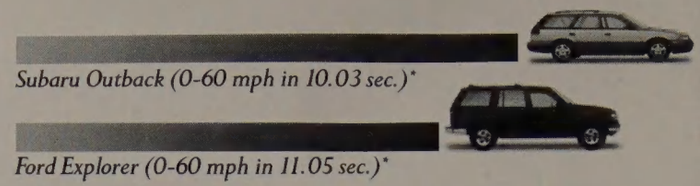
Over the past year, the Subaru Outback® has taken on some of the biggest names in the automotive industry. And to the surprise of many, The World's First Sport-utility Wagon™ has proven a worthy competitor for the world's leading sport-utility vehicles. Never content to rest on our laurels, however, we at Subaru decided to put our foot down. Literally.



the Outback set its sights on a brand-new challenge: zero-to-sixty acceleration. To prove this point, we lined up on the test track next to the famous Ford Explorer and its standard V6.

IN A RECENT TEST OF A
PEDAL WASN'T THE ON

A PEDAL TO THE METAL.

Having already bested the Chevy Blazer on turning stability and conquered the Jeep Grand Cherokee on gas mileage,

*Competitive comparisons based on '96 model year. Outback figures based on '97 model year. Ground clearance comparison based on manufacturer's published specs. Pricing based on '97 MSRP Subaru Outback 4EAT and '96 MSRP for comparably equipped competitive vehicles, not includin

Now at first glance, our 2.5-liter horizontally opposed boxer engine may have appeared to be no match for such a formidable opponent. But thanks to the added traction and control of full-time Subaru All-Wheel Drive, the Outback made quick work indeed of America's number one sport-utility, finishing a full second ahead of its fiercest competitor.

COMPARE THE SUBARU OUTBACK*

	Subaru Outback	Ford Explorer XLT	Chevrolet Blazer LS	Jeep Grand Cherokee
EPA Fuel Economy (city/highway est.)	**21/27**	**15**/20	**16**/22	**15**/20
Ground Clearance (in.)	**7.3**	6.7	8.3	7.8
Front Legroom/ Headroom (in.)	**40.2/43.3**	39.9/42.4	39.5/42.4	37.8/41.4
Pricing	**$23,790**	$27,380	$26,373	$27,840

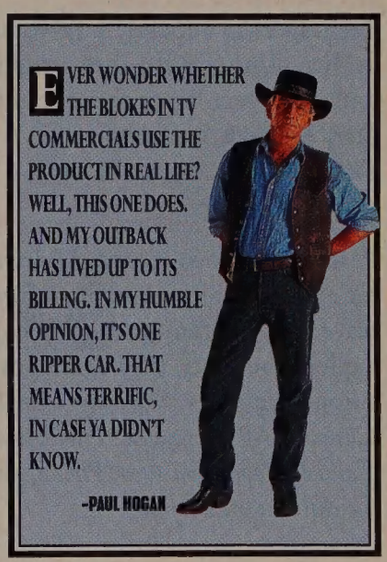
CCELERATION, THE GAS LY THING WE FLOORED.

MORE FAST FACTS.

Of course, speed isn't the only reason the Subaru Outback is off to such a fast start with [The New 1997 OUTBACK®] new car buyers. Its unique hybrid design combines the smooth ride and fuel economy of a passenger sedan with the rugged capabilities of a sport-utility, for a driving adventure that's unlike any other. There's also the added security of the Subaru All-Wheel Driving System, which allows the Outback to constantly monitor changing road conditions and transfer power from the wheels that slip to the wheels that grip. And since it's a Subaru, you'll also find plenty of safety features, including four-channel ABS, side-impact beams, crumple zones and standard dual air bags.†

MAKE IT QUICK.

With credentials like these, it won't take long before sport-utility owners discover the joys of life in the Outback. So see your Subaru dealer for a test-drive, visit our website at http://www.subaru.com or call our toll-free number: 1-800-WANT-AWD. But whatever you do, you'd better step on it. Because these babies really are going fast.


EVER WONDER WHETHER THE BLOKES IN TV COMMERCIALS USE THE PRODUCT IN REAL LIFE? WELL, THIS ONE DOES. AND MY OUTBACK HAS LIVED UP TO ITS BILLING. IN MY HUMBLE OPINION, IT'S ONE RIPPER CAR. THAT MEANS TERRIFIC, IN CASE YA DIDN'T KNOW.
-PAUL HOGAN

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transportation, taxes, license and title fees. Dealer's actual price may vary. Turning stability claim vs. Blazer based on USAC-certified dry lateral acceleration test. 0-60 mph acceleration vs. Explorer with standard V6 engine based on USAC-certified testing. †Always wear seat belts.

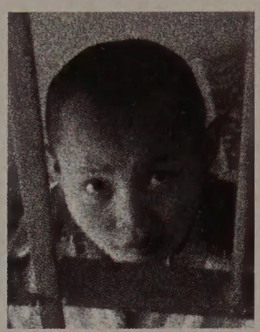
NATURAL HISTORY

July-August 1997 Volume 106 Number 6

Special Issue

Children at Risk

24 Mongolia: Out in the Cold
Street children are a new phenomenon in this country, fallout from the economic crisis precipitated by the collapse of the Soviet Union. *Story by Sherylyn Briller Photographs by Antonin Kratochvil; Saba Press Photos*



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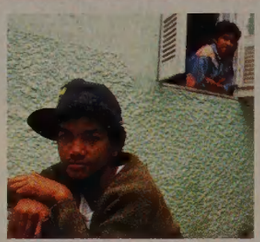
Despite new laws protecting them, street children in Brazil are often viewed as undesirable and expendable. *Story by Nancy Scheper-Hughes and Daniel Hoffman Photographs by J. L. Bulcao; Gamma Liaison*



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Teen-agers in a loosely knit youth gang in a midwestern working-class neighborhood embrace street life with a calamitous zest. *Story by Mark S. Fleisher Photographs by Eugene Richards*

54 Bosnia: After the War Without End
Peace in Sarajevo means children can reclaim the streets on which they once played. Given cameras with which to explore their city, they find signs of life among the ruins. *Story by Colin Finlay and Christina M. Gonzalez Photographs by Colin Finlay; Saba Press Photos, and the children of Sarajevo*

Cover: A street child in Quinta da Boa Vista Park, on the north side of Rio de Janeiro. A special section on the world's street children begins on page 24. *Photograph by J. L. Bulcao; Gamma Liaison*

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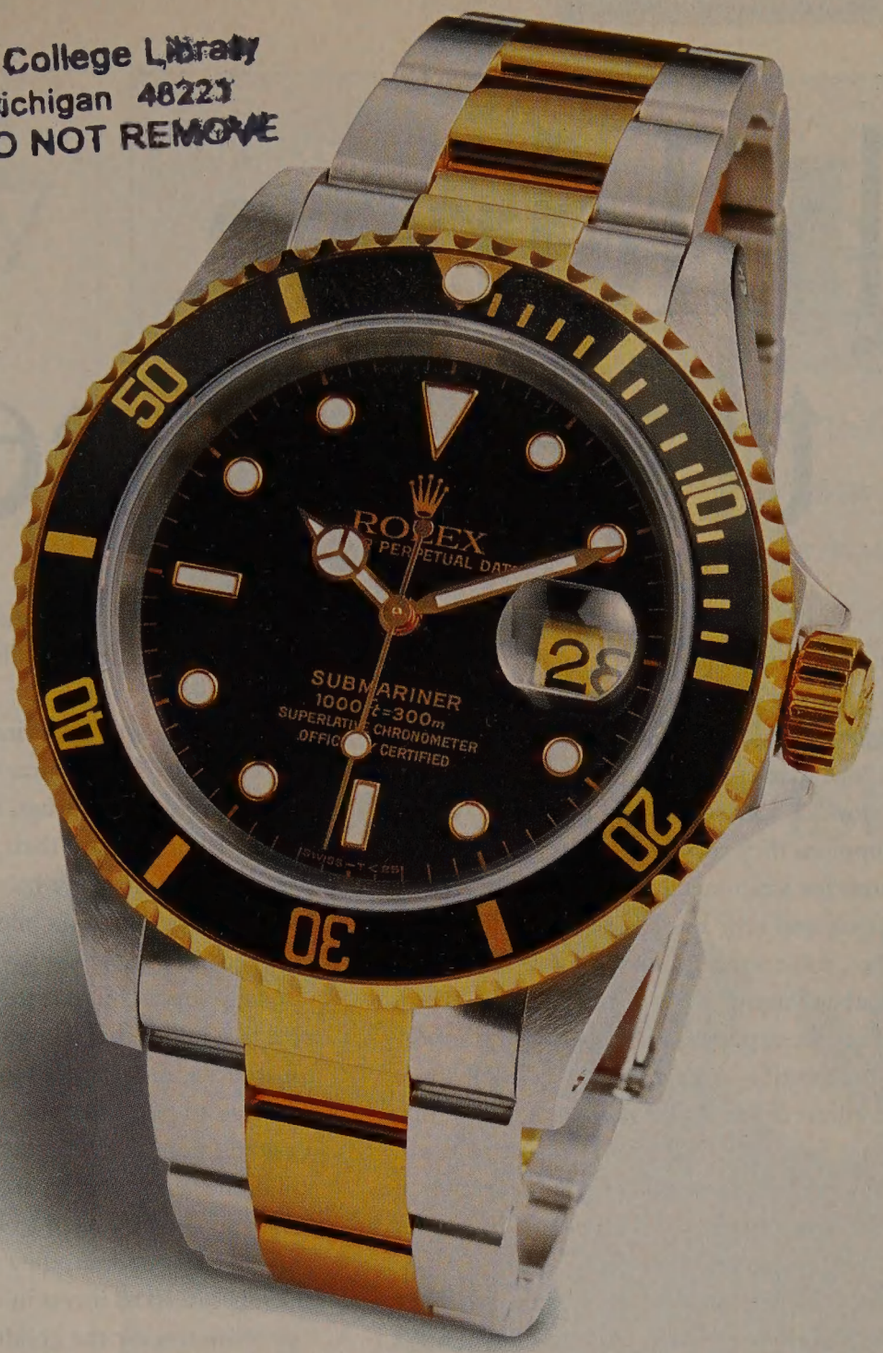

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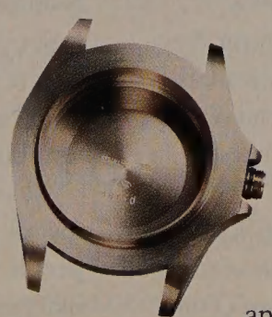

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Children of the Streets

By Carol Bellamy
Executive Director, United Nations Children's Fund

In Peru they are *pajaros fruteros,* or "fruit birds." In Congo they are called *moineaux,* or "sparrows." By whatever name, children forced to work on city streets find ingenious ways to survive. In the Philippines they pray in churches on behalf of customers. They hunt for scrap metal in the slums of Senegal. In Asia, Latin America, and now Eastern Europe, they sell candies and cigarettes, shine shoes, wash car windshields, and scavenge through garbage dumps. These are the more fortunate ones. Others are exploited by pimps and criminals who turn them to prostitution, drug dealing, and theft.

More than 100 million children around the globe live on the streets. (The exact figures are unknown because so few surveys have been conducted among these youngsters, who are among the world's most neglected minorities.) Inhabiting a Dickensian underworld, these street children become stereotyped in the popular imagination. It becomes hard to think of them as individuals, or even as children. The Western image of a street child is of someone who has run away to escape the abuse and neglect experienced at home, but in fact, only some 5 to 10 percent of street children actually sleep on the street. The vast majority return home at night. For them, being on the street is a job. They are working to help keep their brothers, sisters, and parents alive.

Many communities wish they would simply go away. In some places these children are treated—even killed—as though they were little more than vermin. Yet wherever they are, however dangerous and degrading the lives they lead, they are still children, with fundamental rights and expectations, including the right to survive and develop to their fullest potential.

Prior to the International Year of the Child in 1979, practically no attention was paid to the phenomenon of street children. Then in 1981, the United Nations Children's Fund (UNICEF) began its first programs to help abandoned children and those who eke out an existence on the streets. Over the next decade, governments and their leaders began to acknowledge that vast numbers of children were living in unspeakable conditions. There has been progress, but not nearly enough.

These youngsters continue to be exposed to everything that UNICEF's work aims to eliminate: malnutrition, disease, sexual exploitation, drugs, unwanted pregnancies, and black market labor. Girls in their early teens are giving birth on the streets and raising their babies there. There are second- and even third-generation children who have been parented by children. Inevitably, their values differ from social norms.

Many street children see drugs as the solution to their problem rather than as part of the problem itself. In Guatemala, nine out of ten children who live on the street are addicted to paint thinner or glue. In the Colombian capital of Bogotá, more than 95 percent of the city's 12,000 street children spend a good part of their day high on drugs.

These children need to know that they are important and that, like all children, they deserve to be protected and loved. Societies need to invest in education and economic opportunities for the children and their families. (Programs for vocational training have proved successful. The Undugu Society in Kenya, for instance, compresses eight years of schooling into a state-approved, four-year curriculum preparing children for a trade or craft.)

Legislation is also essential. A country's legal code is a statement of society's intent. This is an area where children have been resourceful in obtaining their rights. In Brazil, the National Movement for Street Boys and Girls evolved into a major political and social force that helped enact legislation for the protection and well-being of children. This example must be followed elsewhere. Children have been leading the way, but they are counting on our help, too.

Natural History has taken the unusual step of devoting a special issue to street children, written and photographed by people who have been touched by their subjects' fierce independence. These thoughtful and vividly illustrated articles affirm that street children deserve the world's attention. We cannot, in all good conscience, ignore their needs and their right to healthy and fulfilling lives.

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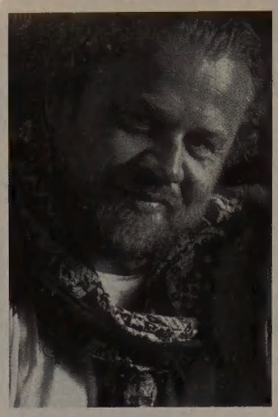
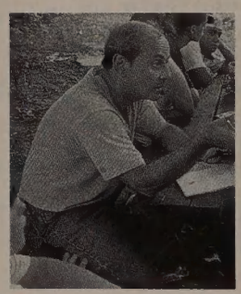
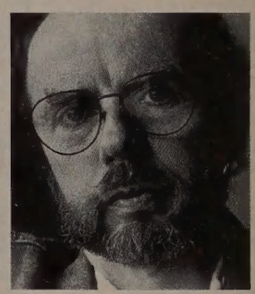


A doctoral candidate in anthropology at Case Western Reserve University, **Sherylyn H. Briller** ("Mongolia: Out in the Cold") recently returned from Mongolia, where she was doing research for her dissertation. There she studied how children, the elderly, and other vulnerable citizens are coping with poverty and other problems following the transition to a post-Communist, free-market society. Born in what is now the Czech Republic, **Antonin Kratochvil** is an award-winning photojournalist with Saba Press Photos. His assignments have included Afghanistan and Rwanda, Tibetan refugees, life in Havana, rain forest destruction in the Amazon Basin, and medical care on Native American reservations. A monograph of his work on Eastern Europe will be published this year by Monacelli Press.

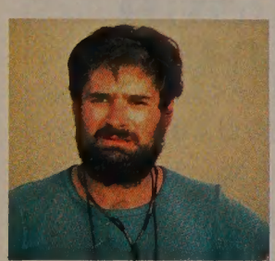
Thirty years ago **Nancy Scheper-Hughes** ("Brazil: Moving Targets") volunteered for the Peace Corps in northeastern Brazil. She went on to conduct anthropological research in Ireland and South Africa, but Brazil kept calling. She returned there for a number of studies, including one that she wrote about for *Natural History* (October 1989) and later expanded into her award-winning book *Death Without Weeping: The Violence of Everyday Life in Brazil.* Scheper-Hughes, chair of the Department of Anthropology at the University of California, Berkeley, goes back to Brazil this summer to study another poverty-induced phenomenon—living organ donors. Her coauthor, **Daniel Hoffman**, above, a doctoral candidate in anthropology at Berkeley, was drawn to Brazil by his interest in human rights and the environment. He is completing a dissertation on the historical relationship between Catholic missionaries and Amerindians in the upper Amazon Basin. A longer version of their analysis of street children's lives will be included in a book to be published in November by the University of California Press. **J. L. Bulcao** started working as a photojournalist in 1989, concentrating on environmental subjects, particularly in the Brazilian state of Amazonas. More recently his photographs have illustrated stories about economic and social conditions in his native Brazil. He now lives in Paris.





Anthropologist **Mark S. Fleisher** ("On the Streets of America") studied the culture and language of the Hesquiat Indians of British Columbia and the Clallam Indians of Washington State before changing his focus to street criminals and youth gangs. An associate professor of criminal justice sciences at Illinois State University, Fleisher, right, is the author of *Warehousing Violence* (Sage Publications, 1989) and *Beggars and Thieves: Lives of Urban Street Criminals* (University of Wisconsin Press, 1995). **Eugene Richards**, far right, a photographer and writer, accompanied Fleisher to document the urban youth-gang story for *Natural History.* The project earned him first prize for Issue Reporting Picture Story (Magazine Division) in the 1996 Pictures of the Year Competition, cosponsored by the Missouri School of Journalism and the National Press Photographers Association. (He was also named Magazine Photographer of the Year.) Richards has received other awards for two books: *Cocaine True, Cocaine Blue* and *Americans We.*

California photographer **Colin Finlay** ("Bosnia: After the War Without End") traveled to Sarajevo last spring to enlist children in an unrehearsed assignment: documenting their own lives. Accompanying him was **Christina M. Gonzalez,** from KTTV in Los Angeles, who helped record the adventure for the Fox network. Finlay's honors include first prize for Issue Reporting Picture Story (Magazine Division) in the 1997 Pictures of the Year Competition. Gonzalez is an award-winning reporter who has also been recognized for community service, including organizing programs for at-risk youths in Los Angeles.



"The nomads I have known consider sand cats to be great snake hunters," says **Alain Dragesco-Joffé** ("Sand Trapped"). Working in the Ténéré desert of Niger, he photographed the sand cat in this month's "Natural Moment" with a Nikon F4 and a 400 mm Nikkor lens. Dragesco-Joffé, who has degrees in both environmental law and ethnozoology, has spent years in the Sahara and was the first naturalist to study the Saharan cheetah. Political strife has led him to suspend his work in North Africa, but he hopes to resume research in Chad and Mauritania. Dragesco-Joffé is the author of many magazine articles and a book, *Saharan Wildlife* (Lausanne-Paris: Editions Delachaux and Niestle, 1993).

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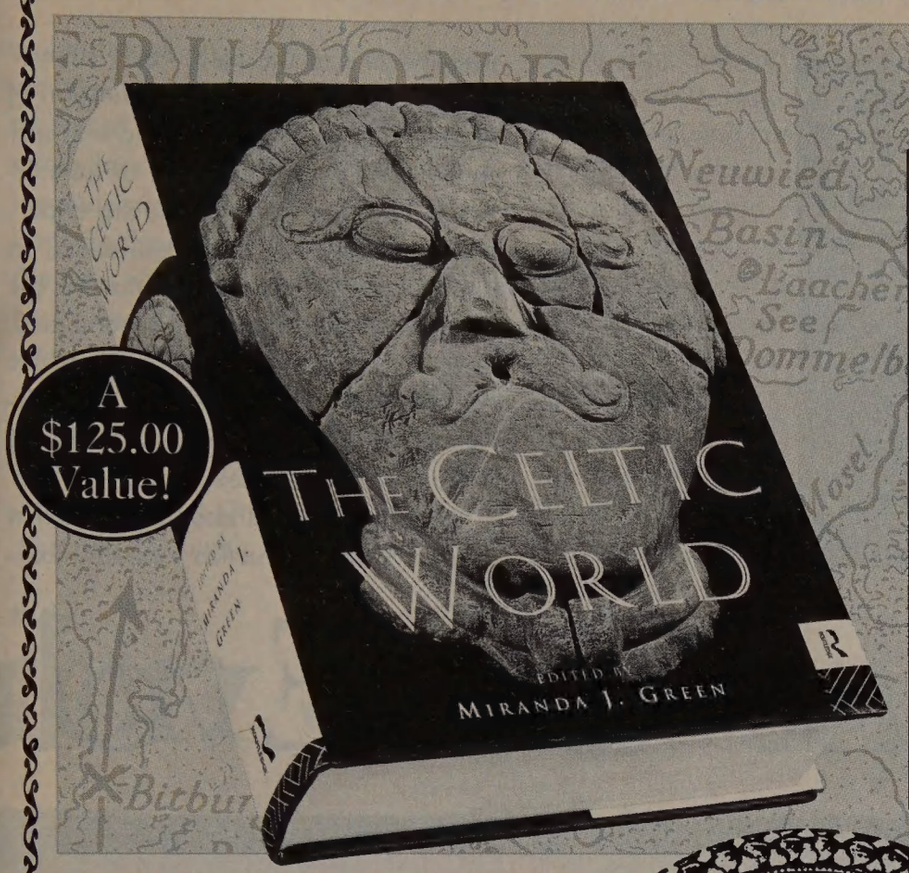

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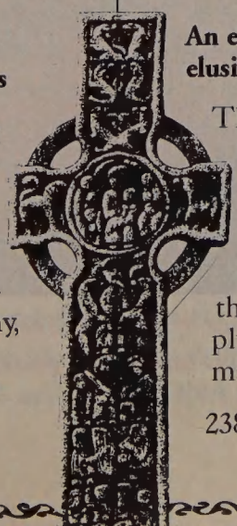

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Michael and Patricia Fogden

The Asian green vine snake is an especially slender species that grows up to six feet in length.

Snakes and the Evolu

By Kurt Schwenk

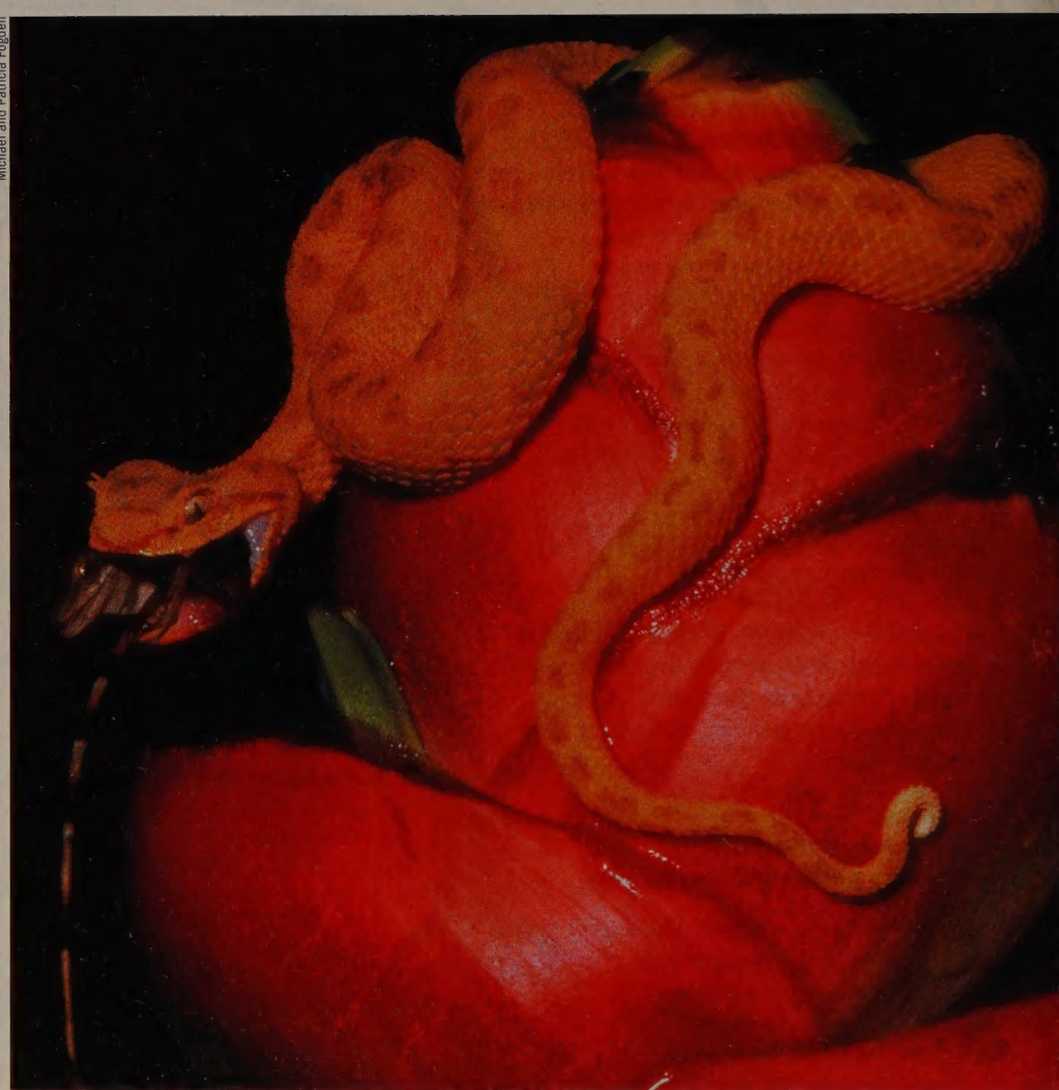
Snakes: The Evolution of Mystery in Nature, *by Harry W. Greene. Photographs by Michael and Patricia Fogden. University of California Press, $45; 351 pp., illus.*

Review

I can think of no better way to capture the essence of this astonishing book than to relate a simple fact: twice while reading it, I was moved to tears. How can a scholarly treatise on the biology of snakes evoke such a response? The answer has something to do with the masterful way Harry Greene, a curator of herpetology at the Museum of Vertebrate Zoology and professor of integrative biology at Berkeley, blends an encyclopedic knowledge of snake natural history with extensive personal experience and insight. And it has something to do with snakes themselves, which for Greene have served as "personal icons of danger, of life and death," guiding his path since childhood.

For many of us, snakes are metaphors for the profound ambivalence we feel toward the natural world. Although we might fear and loathe them, we are drawn to snakes because in their glassy eyes we see mirrored our own duplicity, our own violent intent. Thus it is that the unexpected snake in the path, easily stepped around, is so often killed, a reification of our fear and ignorance. Greene is keenly aware of the symbolic nature of his subject and is able to intermingle this understanding with rigorous scientific fact, so that each way of knowing illuminates the other. In *Snakes,* Greene has combined, in one place and at one time, a massive compendium of snake biology, an explication of snakes and society, and a moving account of his own life's journey.

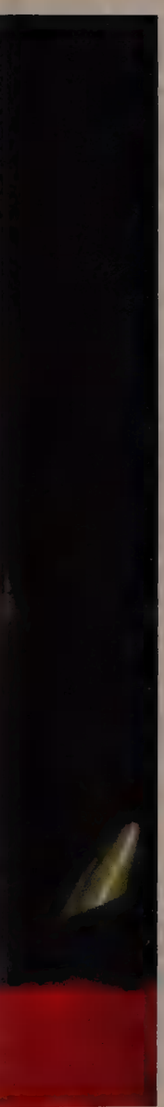
Snakes is organized into three parts that treat the biology of snakes topically, taxo-



Michael and Patricia Fogden

The eyelash pit viper, distinguished by a chunky body and paired infrared-sensing pits between its nostrils and eyes, moves between the ground and the canopy to prey upon frogs, lizards, bats, and birds.

nomically, and in overview. An appendix explains lucidly for the lay reader some of the more technical aspects of biological systematics. Each chapter begins with an introductory essay, which establishes a unifying theme; the themes are later synthesized within a concluding epilogue. Most chapters have "special topic boxes," which treat particular subjects in some detail. The introductory essays and the special topics are, perhaps, the greatest strength of the book because they most clearly manifest Greene's personal style. The prose is highly readable and accessible to all interested naturalists. Professional biologists will mine this book for its wealth of original scholarship. I found myself stopping constantly to jot down notes for later reference in my own research. There is something here for everyone, however, because Greene uses snakes as a platform for general discussions about biodiversity, ecology, and evolution.



The book is richly illustrated with color photographs taken by renowned nature photographers Michael and Patricia Fogden. A Peringuey's adder buries itself in the sand of a vast desert landscape. The silhouette of an Asian green vine snake is revealed through the sunlit leaf on which it rests. These images convey so much more than the outward appearance of a given species. Like the text, the photographs transcend the false dichotomy of scientific objectivity and aesthetic subjectivity to proclaim the beauty of snakes in their own environments.

Although well known for his many scientific contributions, Greene is also an accomplished and committed educator. His concern for teaching at all levels is evident throughout the book. When we first met at Berkeley in 1978, I was a new graduate student, and Greene was a new assistant professor. Our common interest in reptiles drew us together, and during our conversations, his gift as a teacher became apparent. He listened to my nascent ideas—no matter how naïve—and considered them with the same attention accorded those of a distinguished colleague. I have seen him treat with equal respect children, undergraduates, and the public at large. This validation nurtures self-confidence and inculcates students with the understanding that they, too, have something to contribute. I have aspired to this simple quality in my own teaching.

Greene is the quintessential field biologist, and his experiences in the field are the strongest parts of the book. I had the good fortune to accompany him on many trips to the Mojave Desert—for me, profoundly educating breaks from the lab during my graduate years. One crystalline, still morning in Darwin Canyon, our attention was drawn to the wildly swaying branches of a creosote bush. There, climbing easily, if not gracefully, among the overburdened twigs, was a large lizard, an adult chuckwalla, gorging on a spring delicacy of yellow flowers. As any ecologist will tell you, chuckwallas are strictly rock and crevice dwellers and are assuredly not arboreal.

Yet animals do unexpected things in nature, and this is a theme Greene returns to throughout the book. Fossorial blind snakes climb trees, and yellow-bellied sea snakes drift on the ocean with the plankton. DNA tells us nothing of these things, nor can laboratory studies predict them. A complete understanding of evolution and adaptation requires context, and, as Greene asserts, only direct observations of the organism in the field can provide it. Through his extensive field experience, Greene is able to share this context and so enrich us.

Only Harry Greene could have written *Snakes;* it bears the unique imprint of his life and career. It therefore seemed ironic that he opened the book with a self-deprecatory anecdote. He recounts a 1993 meeting with Norman MacLean (author of *A River Runs Through It*), in which MacLean urged him to write about what he knew. The meeting, for Greene, was somewhat of a disappointment: "It took several years to abandon my earlier pretensions, admit that I was unable to say much about more personal matters, and appreciate the wisdom of his advice." But in writing about what he knows best, Greene's voice is intensely "personal," and therein lies the triumph of this book.

Kurt Schwenk

Harry Greene, left, with a colleague and a speckled rattlesnake

tion of Harry Greene

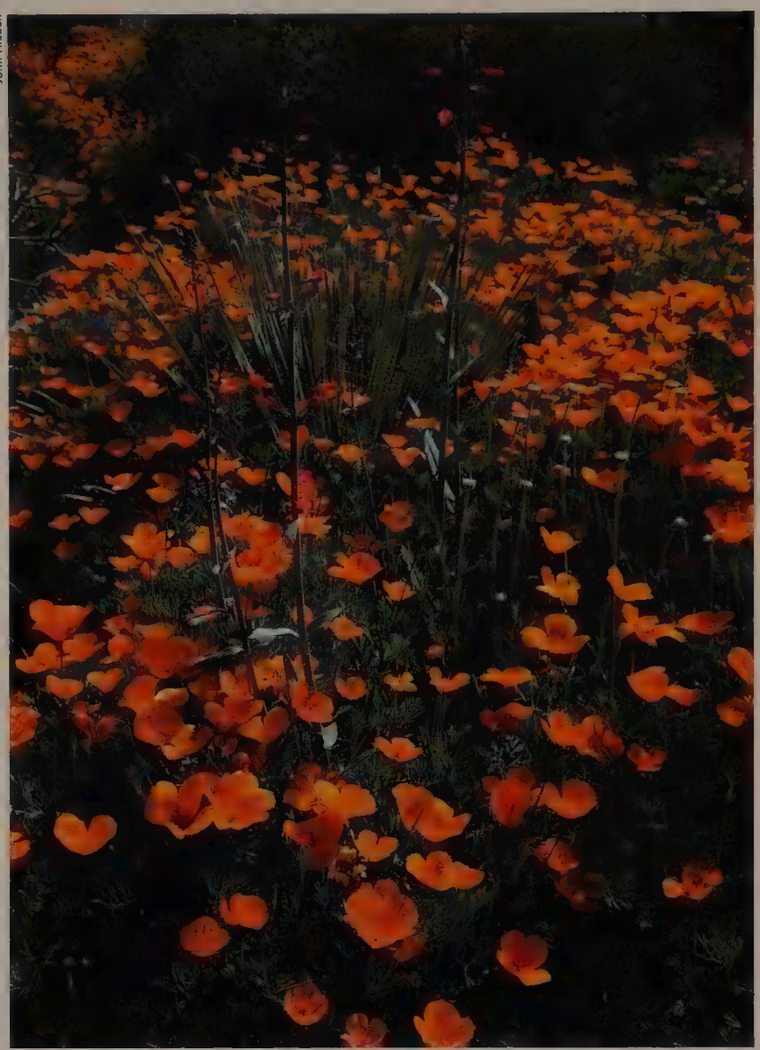
Kurt Schwenk, an associate professor of ecology and evolutionary biology at the University of Connecticut, researches the functional morphology of lizards and snakes and the evolution of their feeding and chemosensory systems.

Front-Yard Revolution

One late spring day in 1988, John Alcock, a professor of zoology at Arizona State University and longtime resident of Tempe, decided to replace the Bermuda grass lawn in his yard with gravel and a diversity of desert plants. While he enjoyed gardening, he relished even more the opportunities for insect watching. "How fortunate we are to live on a planet where insects rule supreme," he writes. "We need not mount an elaborate expedition to deepest anywhere to find an animal whose ways of doing things can astonish and amaze us, fill us with questions, and teach us about the frontiers that exist just outside the front door."

Excerpted from In a Desert Garden: Love and Death Among the Insects, *by John Alcock. Copyright 1997 by W. W. Norton. Reprinted with permission from the publisher.*

John Alcock



The paloverde's spring flowers attract bees and butterflies.

Excerpt Almost all of the plants that I permitted to grace my yard were local Sonoran Desert species. Well, a few (such as the golden barrel cactus) did come from Mexico, and an even fewer, such as the South African aloes and an Australian poverty bush, somehow managed to convince me they belonged despite their un-American provenance.

Although the number of transplants sounds substantial, their planting was actually spread out over many weeks, with additions and replacements right up to the present. Early on, even after several dozen plants had been put in place, the yard still looked empty, abandoned, displaying none of the happy clutter of a native patch of Sonoran Desert that I knew so well. I realized patience would be required.

Some friends and colleagues urged a drip irrigation system for the plants now scattered among the gravel. Once again, frugality won the day. No plant unable to survive without major technological assistance had a place in my front yard. Each of the plants that I ushered into its new, hard-packed clay home was thoroughly watered on its day of planting and then again at ever greater intervals. Almost all have survived, and most have thrived, confirming the wisdom of my penny-pinching negativity with respect to drip irrigation lines and timers.

As the years have passed, these immature youngsters planted so long ago have grown dramatically, filling in many of the open spaces that appeared nude in the desert yard's babyhood. The yard now has the look of chaparral. To maintain some suggestion of desert, I have on occasion had to dig up and cart away a few original colonists and their offspring. Globe mallow and brittlebush sometimes get carried away with the pleasures of "captivity," taking full advantage of the relative absence of competition from neighboring plants, expanding almost overnight when it rains, so much so that my current policy is never ever to run the hose out to them. Were they to receive extra water, they would balloon completely out of control, sprawling outward, reaching higher and higher, achieving a mass well beyond the restrained dimensions of their true desert cousins.

In nature, baby penstemons, brittlebush, and globe mallow all like open, disturbed areas, such as the edges of dry desert washes or hillside gullies. This preference for disturbed soil makes them perfect for unnatural yards in a perpetual state of rearrangement. I, for one, relish the opportunities for micromanagement offered by my desert yard. It took me a spring or two, but eventually I learned which miniature seedling would grow into a penstemon and which was the product of an unwanted weed, the

Assassin bug with prey

better to save the former and destroy the latter. I could then transplant baby penstemons in winter, creating small clusters of the plants where I imagined they would flower for maximum effect. In drought years, I have to water the transplants in winter and early spring, but they more than repay my attention.

Their glorious display of flowers attracts a bevy of bees, to say nothing of Anna's and black-chinned hummingbirds.

Swallowtail butterfly

In March or April, I can count on having a half dozen jet-black carpenter bees and several hummingbirds rocketing from one clump of penstemons to the next in appreciation of my winter manipulations.

Therefore, my current yard is always in a state of disequilibrium rather than in the nearly static condition that characterized its Bermuda-grass days. Some shrubs come and go; new individuals arise from seeds dropped by adult plants; in the spring, a whole collection of small annual flowering plants, among them desert poppies and Mojave desert bluebells, have their brief moment in the sun before adding seeds to the gravel for storage until the winter rains.

From a botanical perspective, my diversified desert yard is a thousand times more interesting than the grass "desert" it replaced. Moreover, it is an entomological paradise; in sum, the conversion has been richly rewarding. As a result of the much greater variety of plant species in the yard—ranging from trees to desert shrubs and ephemeral annuals to Swiss chard and tomatoes—the food niches available for exploitation by particular insect species have been greatly expanded. Carpenter bees and globe mallow bees, brittlebush aphids and milkweed aphids, these and many other insects can now be accommodated in an enriched environment. I sing the diversity of plants. Down with Bermuda grass! Long live penstemons! Up with insects! □

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Summer Reading

The Natural History of the Long Expedition to the Rocky Mountains (1819-1820)

By Howard Ensign Evans (Oxford University Press, 1997, $15.95, illus.)

The government-backed expedition of Major Stephen H. Long mapped a previously unknown part of the Louisiana Purchase—the high plains and the front range of the Rocky Mountains. Evans, a professor emeritus at

American Philosophical Society

Watercolor by Titian Peale, 1820

Colorado State University, has retold the story of this expedition, using the reports, journals, and artwork of participants, including entomologist Thomas Say, artists Titian Peale and Samuel Seymour, geologist Augustus Jessup, journalist James Bell, and botanists William Baldwin and Edwin James.

The Names of Things

By Susan Brind Morrow (Riverhead Books, 1997, $25.95, illus.)

An archeologist, poet, translator, and naturalist, Morrow spent the 1980s traveling in Egypt and the Sudan. In this volume, she describes the people, natural history, and extremes of landscape in these countries: among the highlights are an archeological dig in Egypt's western desert, a trip on a crowded ferryboat in the vast marshland of the Upper Nile, and a visit to Cairo, "where the chaos of human life spreads like a dense fog through the streets."

Fieldwork

By Christopher Scholz (Princeton University Press, 1997, $24.95, illus.)

Scholz looks back on his three months in Botswana in 1974, when he was a "freshly minted and tenured thirty-year-old associate professor" at Columbia University's Lamont-Doherty Geological Observatory. In the 300-mile area of the Kalahari Desert that includes the wetlands known as Okavango, Scholz and Teddy Koczynski (a Lamont-Doherty technician) surveyed evidence of microearthquakes and proved that a previously unknown rift—an arm of the East African Rift System—could spread without leaving any traces of volcanism.

Equinox

By Dan O'Brien (Lyons and Burford, 1997, $22.95, illus.)

For South Dakota rancher and writer Dan O'Brien, falconry is a passion, and while his wife is on a year's fellowship back East, he devotes himself to raising and training a brood of falcons. He writes lyrically about his birds, about the important and subtle ways his dogs work with them, and about plants and animals of South Dakota's high plains. The lingo is rich but obscure for outsiders, and O'Brien has helpfully included explanations, in the margins, of such words as "stoop" (a falcon's dive from a height) or "tiring" (a tough piece of food given to a falcon or hawk).

Hawks in the Hand

By Frank and John Craighead (Lyons and Burford, 1997, $35, illus.)

The Craighead twins were teen-agers when they wrote about "adventures in photography and falconry" in this, their first book, published in 1938 and now reissued. Like *My Side*

Courtesy of National Geographic

Frank Craighead with great horned owls

of the Mountain, by their sister Jean Craighead George, or *Two Little Indians,* by Ernest Thompson Seton, this story of two young naturalists inspired a generation to actively explore the natural world.

Fishcamp

By Nancy Lord (Island Press/Shearwater Books, 1997, $22.95, illus.)

Nancy Lord has fished Cook Inlet in southwestern Alaska for the last eighteen summers. The backbreaking and precarious labor involved in "setnetting" salmon does not diminish Lord's appreciation of the plants and animals surrounding the fishcamp, the geological features of the rock on which her camp is built, and the ways and spirits of the departed Dena'ina Indians.

Big Bluestem

By Annick Smith (Council Oak Books, 1996, $34.95, illus.)

The Nature Conservancy's Tallgrass Prairie Preserve was once a 37,000-acre cattle ranch in northern Oklahoma. Naturalist-filmmaker Smith examines the natural history of the land, as well as the impact humans have had on it. By reintroducing bison and selective burning practices, the Conservancy hopes that the original grasses and forbs of the tallgrass prairie—big and little bluestem, switchgrass, hairy grama, and compass plant—will return. About 200 color photographs by Harvey Payne and 100 black-and-white archival pictures are included.

A Year's Turning

By Michael Viney (Dufour Editions, Inc., 1997, $24.95, illus.)

Viney, a journalist and filmmaker, lives with his wife on an acre bounded by "hawthorn quicks" on the west coast of Ireland. His book, a naturalist's diary, records his observations of the natural world—from the pygmy shrew with its tiny, ruby-red-tipped teeth "designed for chomping woodlice, beetles or spiders" to froglets thronging the water "like pilgrims bathing in the Ganges" to the rare True's beaked whale that washes up on the sand. Viney's line drawings enhance his fine, funny, lyrical writing.

Kingbird Highway

By Kenn Kaufman (Houghton Mifflin Co., 1997, $23, illus.)

With the publication in the 1930s of Roger Tory Peterson's *Field Guide to the Birds,* birding developed into a popular American pastime. Kaufman says the book "took bird recognition out of the domain of the specialist and made it possible for everyone." By the late 1960s, bird-watching had become a competitive sport, and Kaufman joined the groundswell, leaving his Kansas home at sixteen and hitchhiking around the country to see as many different kinds of birds as possible. He saw 671 different North American species in 1973—almost the record—but what is more amazing is that bird-watching could motivate a teen-ager to travel 69,000 miles in one year on less than $1,000.

The books mentioned in "Natural Selections," if currently available from the publisher, may be ordered from the Museum Shop of the American Museum of Natural History (212) 769-5150.

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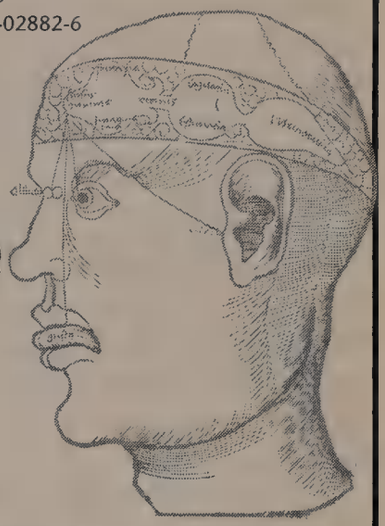

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Seeing Eye to Eye

By Stephen Jay Gould

We laugh at the stuffiness of Victorian pronouncements, as typified by the quintessential quotation from the woman who gave her name to the age—the queen's reaction to an imitation of herself by her groom-in-waiting (as stated in the regal first person plural): "We are not amused." Yet we (that is, all of us poor slobs today, not her majesty alone) must also admire the unquestioned confidence in matters both moral and material of our Victorian forebears, especially from the ambivalent perspective of our own unsure and fragmented modernity.

In a popular book of the mid-1850s, Shirley Hibberd (an androgynous name, but male in this case, as for most publicly eminent Victorians) praised the acme that his age had achieved not only in larger affairs of state but also in the domestic tranquillity of homes:

> *Our rooms sparkle with the products of art, and our gardens with the curiosities of nature. Our conversation shapes itself to ennobling themes, and our pleasures take a tone from our improving moral sentiments, and acquire a poetic grace that reflects again upon both head and heart.*

Hibberd argues for an intimate tie between happy homes and triumphant governments, for "our domestic life is a guarantee of our national greatness." But how shall such purity and edification be achieved on the home front? Hibberd appeals to the concept of taste:

> *A Home of Taste is a tasteful home, wherein everything is a reflection of refined thoughts and chaste desires. . . . In such a home Beauty presides over the education of the sentiments, and while the intellect is ripened by the many means which exist for the acquisition of knowledge, the moral nature is refined by those silent appeals of Nature and of Art, which are the foundations of Taste.*

Since Hibberd was a nature writer by profession, and since I am quoting from his most famous work, entitled *Rustic Adornments,* readers will not be surprised

Aquariums, the pride of Victorian drawing rooms, permanently changed our view of sea creatures.

by his primary prescription for domestic improvement: the enhancement of good taste by cultivated displays of living things. "The Rustic Adornments of the household," Hibberd asserts, "embrace the highest of its attractions apart from the love which lights the walls within." Hibberd could not have been more sanguine about the beneficial moral effects of an interest in natural objects:

> *It would be an anomaly to find a student of nature addicted to the vices that cast so many dark shadows on our social life; nor do I remember among the sad annals of criminal history, one instance of a naturalist who became a criminal, or of a single gardener who has been hanged.*

So much for the Bird Man of Alcatraz! Moreover, an interest in nature defines both our tranquillity and our prosperity—no strife or ignobility please, we're British!

> *It is because we are truly a domestic people, dearly attached to our land of green pastures, and shrubby hedgerows, and grey old woods, that we remain calm amid the strife that besets the states around us, proud of our ancient liberties, our progressing intelligence, and our ever-expanding material resources.*

But nature has always been out there for our edification on her turf. The greatest advance of his age, Hibberd argued, lay in the invention of devices—rustic adornments—that allowed home-dwellers, even of modest means in highly urban settings, to cultivate nature within domestic walls. Hibberd's book contains successive chapters on all forms of indoor natural display, from fern cases to aviaries to floral arrangements. But he devoted his opening chapter to the great craze that defined his decade of the 1850s—the establishment of marine aquariums in almost any home coveting a cachet of modernity. "I commence," Hibberd writes,

> *with the Aquarium, which for its novelty, its scientific attractions, and its charming elegance, deservedly takes the first among the Adornments of the House.*

Aquariums seem so humble in concept and so common in occurrence—a staple of your dentist's office or your kid's bedroom—that we can hardly imagine an explicit beginning or a notion of original excitement and novelty. In fact, the aquarium had a complexly interesting and particular birth during the mid-nineteenth century and then enjoyed (or endured) one of Victorian Britain's most intense crazes of popularity during a definite interval in the 1850s. I do not, of course, claim that this invention marks the first domestic display of aquatic or-

ganisms. The owner of any respectable Roman villa could look down upon the animals in his fishpond. Similarly, the simple bowl had allowed, also since classical times, the contemplation of a fish or two in the more direct, edge-on, eye-to-eye orientation (through glass or some other transparent medium that did not always come easily or cheaply before the last few generations).

But these precursors are not aquariums in the technical sense, for they lack the defining feature: a stable community of aquatic organisms that can be viewed, not from above through the opacity of flowing waters with surface ripples, but eye to eye and from the side through transparent glass and clear water.

A fishbowl is a temporary display, not a stable community. The water quickly goes foul and must be changed frequently (engendering the amusing and frustrating problem, so well remembered by all childhood goldfish enthusiasts, including yours truly, of netting your quarry for temporary residence in a drinking glass while you change the water in its more capacious bowl—a process that can keep Grumpy the Goldfish going for a while, but surely cannot sustain a complex community of aquatic organisms).

The concept of an aquarium, on the other hand, rests upon the principle of sustained balance among chemical and ecological components—with plants supplying oxygen to animals, fish eating the growing plants, and snails (or other detritus feeders) scavenging the wastes and gobbling up any algal film that might grow on the glass walls. The basic chemistry of oxygen, respiration, carbon dioxide, and photosynthesis had been worked out by Western science only in the late eighteenth century, so the defining concept scarcely existed in a usable way before then.

The aquarium represents but one of many practical results for this great advance in human knowledge. To quote Hibberd again:

> *The Aquarium exemplifies, in an instructive manner, the great balance of compensation which, in nature, preserves the balance of equilibrium in animal and vegetable life.*

A few naturalists, before the invention of the aquarium, had managed to keep marine organisms alive for considerable periods in indoor containers, but only with sustained and substantial effort (entrusted to domestic servants, and therefore reflecting another social reality of the times).

For example, Sir John Graham Dalyell, a Scottish gentleman with the euphonious title of sixth baronet of Binns and a day job as a barrister (which en-

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hances the alliteration), maintained marine animals in cylindrical glass vessels during the early years of the nineteenth century. But he kept only one animal in each jar and had to change the water every day, a job allocated to his porter, who lugged several gallons of seawater from nearby ocean to baronial home at least three times a week in his trusty earthenware jar. Sir John did enjoy substantial success. His hardiest specimen, a sea anemone he named Granny, moved into its jar in 1828 and survived until 1887, long outliving the good baronet and several heirs who received this lowly but hardy coelenterate as a dubious legacy.

(The history of aquariums has spawned a small but thorough literature. I read this story of Sir John in an excellent article by Philip F. Rehbock, "The Victorian Aquarium in Ecological and Social Perspective," in *Oceanography: The Past,* edited by M. Sears and D. Merriman [Springer Verlag, 1980]. I also benefited from Lynn Barber's general book *The Heyday of Natural History 1820–1870* [Doubleday, 1980]. But I have relied mostly on two primary, nineteenth-century sources from my personal library: Shirley Hibberd's *Rustic Adornments,* and the classic work *The Aquarium: An Unveiling of the Wonders of the Deep Sea,* by Philip Henry Gosse, one of the greatest Victorian naturalists.)

In a similar story, recounted by all major sources on the origin of aquariums, Mrs. Thynne, a lady of means, brought some corals from Torquay to London in 1846 "for the purpose of study and the entertainment of friends" (again quoting Hibberd).

A stone jar was filled with sea-water; the madrepores [corals] were fixed on a large sponge by means of a needle and thread. They arrived in London safely, and were placed in two glass bowls, and the water changed every other day. But the six gallons of water brought by Mrs. Thynne was now exhausted and must be used again. She here devised a means to freshen it for second use.

All photographs by J. Beckett; AMNH

In J. J. Scheuchzer's Physica sacra *(published in the 1730s), marine invertebrates are arranged in "preaquarium" perspective.*

We now switch to Mrs. Thynne's own account, and to another statement about the source of actual work in homes of leisure:

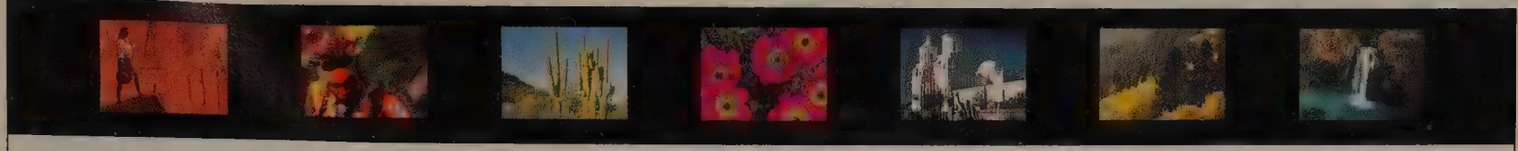
I thought of having it aerated by pouring it backwards and forwards before an open window, for half or three-quarters of an hour between each time of using it. This was doubtless a fatiguing operation; but I had a little housemaid, who, besides being rather anxious to oblige me, thought it rather an amusement.

In later experiments, Mrs. Thynne did add plants to approximate a natural and sustaining balance, but she never abandoned her practice (or her housemaid's effort) of aeration by hand, and thus never built a truly self-sustaining aquarium:

I regularly placed seaweed in my glass bowls; but as I was afraid that I might not keep the exact balance required, I still had the water refreshed by aeration. I do not know from which, or whether it was from both causes, that my little flock continued to thrive so much, but I seldom had a death.

Interestingly, the key discovery that led to the aquarium of the 1850s arose not from direct experiments with marine organisms but by creative transfer from another technology for rustic adornment that had spawned an even more intense craze during the 1840s—the Wardian case, a small, almost airtight container for growing and sustaining plants.

Nathaniel Bagshaw Ward, a London surgeon by profession, began his experiments in the late 1820s. By enclosing plants in a "closely glazed case" (his terminology), Ward learned how to encourage growth and avoid either desiccation or fouling of the air, all without human input or interference. The moisture transpired by plants during daylight hours would condense on the glass and



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drip back down to the soil at night. So long as the case remained sufficiently sealed to prevent the escape of moisture, but not tight enough to preclude all movement of gases in and out (so that oxygen could be replenished and carbon dioxide siphoned off), the Wardian case could sustain itself for long periods of time.

Ward's invention provided far more than a pleasant bauble for moral enlightenment in Hibberd's settings of domestic bliss, for the closely glazed case played a key role in Victorian commerce and imperial expansion. Plants in Wardian cases could survive for months at sea, and distant transport became practical for the first time (for species not easily cultivated from seed). In her book *The Heyday of Natural History,* Lynn Barber writes:

> *The directors of Kew Gardens began to plan even more large-scale movements of plants. . . . Literally millions of plants were ferried to and fro in Wardian cases, [and] they eventually succeeded in establishing tea as a cash-crop in India (from China) and rubber in Malaya (from South America), thus adding two valuable new commodities to the British Empire's resources. Kew's Wardian cases were probably one of the best investments the British Government has ever made, and in fact they were only very recently superseded by the use of polythene bags.*

Until the mid-nineteenth century, marine organisms were almost always drawn from a terrestrial vantage point.

Scheuchzer's marine fishes (seen on the surface of the ocean and as a framing garland) are portrayed from the top-down vantage point of a shorebound observer.

On a humbler yet massive scale, Wardian cases also became a fixture in almost every British home of approved taste. Although many kinds of plants could be grown in such cases, a passion for ferns—so spectacular as a social fad that the epidemic even received a Latinate description as pteridomania, or the fern craze—swept Britain in the 1840s. When this mania inevitably subsided, the technology of Wardian cases remained, ready to be utilized for the next passionate bout of rustic adornment—the aquarium craze of the 1850s.

All fads, however brightly they may flare for the moment, seem to burn out in relatively short order. The aquarium craze dominated amateur interest in natural history during the 1850s, but quickly subsided during the next decade. By 1868 another popular naturalist, the Reverend J. G. Wood, could write:

> *Some years ago, a complete aquarium mania ran through the country. Everyone must needs have an aquarium, either of sea or fresh water, the former being preferred. . . . The fashionable lady had magnificent plate-glass aquaria in her drawing room, and the schoolboy managed to keep an aquarium of lesser pretensions in his study. . . . The feeling, however, was like a hothouse plant, very luxuriant under artificial conditions, but failing when deprived of external assistance. . . . In due course of time, nine out of every ten aquaria were abandoned. . . . To all appearance the aquarium fever had run its course, never again to appear, like hundreds of similar epidemics.*

Even the most ephemeral episode of public fascination teaches us many lessons about the social and ideological context of all scientific movements. We have already seen how the aquarium craze relied upon chemical discoveries, a philosophical notion about natural balances, a social system that supported a substantial class of domestic servants in wealthy homes, and the development of a technology first exploited in a previous craze for ferns. Further reading reveals other important ties to political and technological history, most notably the necessary repeal, in 1845, of the heavy tax that had been levied upon glass. Gosse's how-to

(Please turn to page 60)

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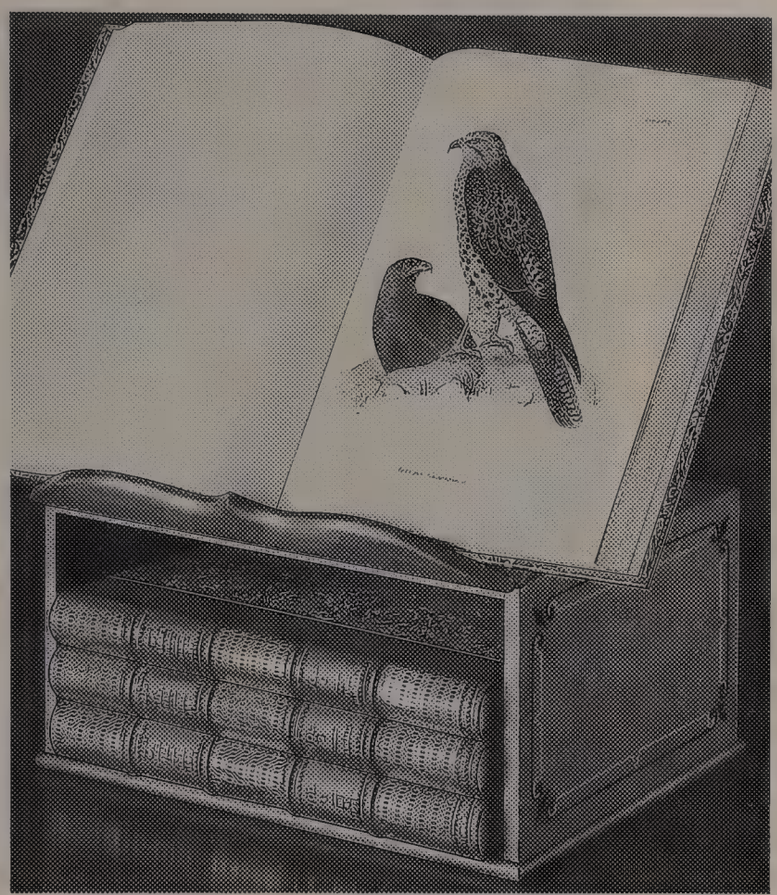

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Making

Unlike bungee jumpers, caterpillars hanging from self-deployed silken lines must climb back up. Here we reveal the secrets of their ascent.

Story by John Brackenbury
Photographs by Darlyne A. Murawski

The curl: Seeming to flail its body, an inchworm swings its abdomen up toward the silk line. The curl is a risky maneuver, as all the legs grasp at the line, but the ascent is swift.

Imagine you're dangling at the end of a rope. If you're an athlete, able to marshal your exceptionally coordinated muscles, you can ascend to a flat haven at the top of the line. Assuming you have superior upper body strength, you could let your legs dangle and use the energy-intensive arm-over-arm technique to pull yourself upward. More likely, you'll get your lower extremities into the act, gripping with your arms, then with your feet and legs, to hoist yourself toward your destination. The latter strategy can be sustained longer because it engages more of your available body power. Once you reach your imaginary summit, you stride off confidently on two legs.

Now imagine that you're a moth caterpillar dangling at the end of a rope, or in this case, a slender silken line spun out of organs in your head. A predator's threat has prompted you to deploy this lifeline, and you have briskly parachuted down the thread to escape. Now the predator is gone, and all you have to do is climb back up to a familiar surface. But can your multiple pairs of legs and the undulations that move you along on a flat surface propel you straight up a line a fraction of the diameter of a human hair?

Of all forms of locomotion, undulation of the body is one of the simplest and most widespread. Worms, centipedes, fishes, lizards, and snakes undulate from side to side, as do the backbones of terrestrial mammals when they are walking. Animals such as whales, dolphins, maggots, and caterpillars undulate in the vertical plane. To understand how a caterpillar manages to climb a silk line, we should first analyze the biomechanics of its basic way of moving.

On the "flat," moth caterpillars can be loosely classified as either shufflers or loopers. The extremely hairy caterpillars of the tiger moth family, while too hefty to use the silk line defense, are exemplars of the undulatory shuffle. A good example of this kind of caterpillar is the brown-and-black woolly bear—the larva of the Isabella moth—frequently encountered on roads and paths in late summer.

Caterpillar bodies consist of a head, a three-segmented thorax, and a ten-segmented abdomen. Shufflers generally possess a pair of "true" legs on each tho-

Waves

The side-to-side: Waving its upper body methodically to and fro, a caterpillar ascends by wrapping the silk around its third pair of legs, letting the rest of the body dangle.

racic segment and a pair of so-called false legs, or prolegs, on abdominal segments three through six. A terminal pair, called claspers, are on segment ten. Forward movement is brought about by a wave that begins at the tail end and progresses forward, body segment by body segment. Each segment is raised and telescoped toward its neighbor ahead in line, then lowered. At the same time, the legs attached to the segment are withdrawn from the ground, moved forward, then extended to make contact with the ground again. This sequence is repeated until every segment has taken a tiny step. The telescoping movements result from the phased activity of the dorsal and ventral longitudinal muscles of each segment, while the prolegs are drawn in by specialized retractor muscles. The transmission of the wave along the body is further assisted by the pressurization of the fluid-filled body cavity as the various muscles contract, and hydrostatic pressure helps move the prolegs back out.

From a biomechanical point of view, the problem with shuffling is that too many legs inhibit a caterpillar's ability to move quickly or economically. Each pair of legs need to take a ministep before the whole body can be seen to take a whole step forward. No single segment can be allowed to rise very far off the ground.

Loopers, or inchworms (typified by geometrid, or "ground measurer," caterpillars), have overcome this problem by keeping the thoracic legs and streamlining the abdomen, making do with just one pair of legs on segment six plus the claspers. Now, instead of a series of shuffling steps, a giant step can be taken by arching the legless middle segments up, allowing the end of the body to be brought right behind the thorax.

Looping is one way that caterpillars modify the basic undulatory principle on the ground. When they are "rope climbing," loopers and small shufflers show how the principle can be further adapted even when contact with the ground has been lost. Various moth caterpillars regularly parachute through the air at the end of silk lines, either to disperse or to escape predatory birds and parasitic ichneumon wasps (the latter use the living bodies of caterpillars as repositories for their eggs). This escape strategy is also known as spinning down.

Similar to spider silk, caterpillar silk is secreted by two modified salivary glands and passes through a spinneret near the larva's mouth. The silk is both elastic and strong. It stretches up to 25 percent of its initial length to break the caterpillar's fall and can bear eight to ten times the body weight of its larval load. (If still alarmed, the caterpillar can spin out more line.)

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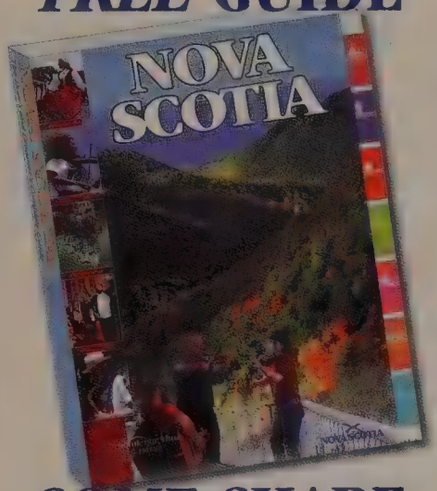

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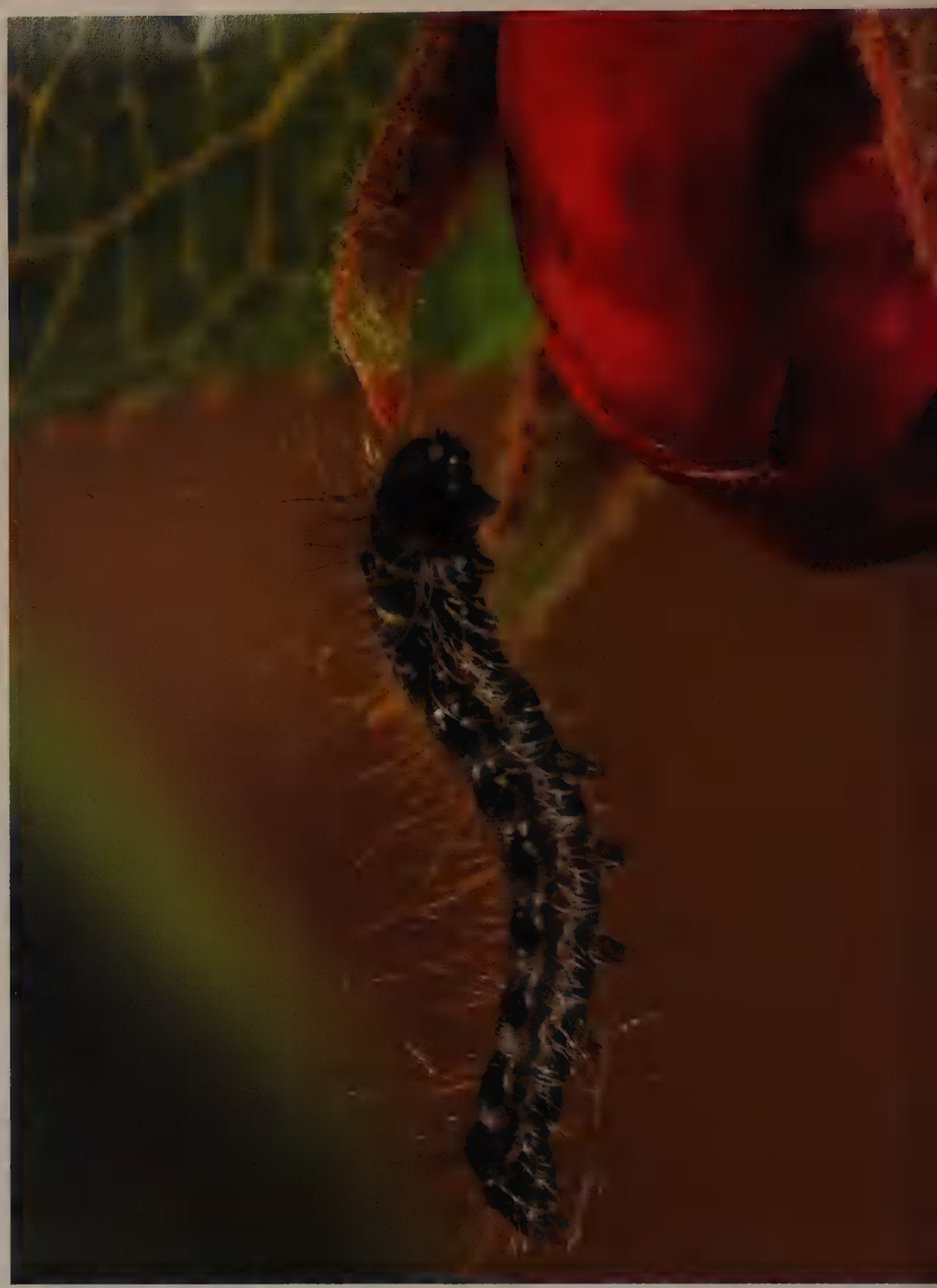


About to reach its destination via the curl technique, a tent caterpillar has engaged its abdominal legs and passed the silk line down the length of its body.

To determine just how caterpillars scale silken ropes, I set up a video system in my lab at Cambridge University and analyzed the larvae's movements in frame-by-frame playbacks. My main subjects were two small, grayish shufflers common in Europe: *Epinotia abbreviana,* a solitary, leaf-rolling species that inhabits elm leaves, and *Yponomeuta padella,* a communal species that spins and lives in silky tents in the branches of blackberry bushes.

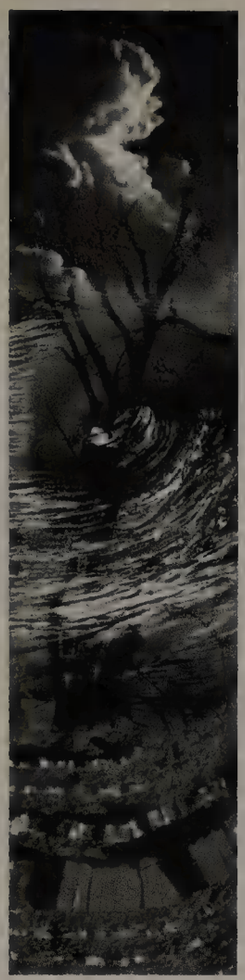
A caterpillar that has spun down usually hangs by its mouth on the line for a few seconds before ascending by one of two methods. The climbing technique most often used is the easier but slower of the two. The caterpillar appears to the naked eye to shuttle up the line by gently waving its head and thorax side to side. My high-speed videos show that during this process, the thoracic legs, first those on one side of the body and then those

on the other, reach forward and grasp the lifeline. The silk ends up being wound in a neat bundle around the third pair of thoracic legs, like yarn around a person's outstretched arms. This rhythmic process involves the nervous system, muscles, and, presumably, tactile feedback from the feet. The technique is regularly used by ground-measurers, leaf rollers, and other moth caterpillars.

The communal tent-dwelling caterpillar that I studied sometimes uses the side-to-side method, but at other times opts for a hurried and more energetic means of ascent, during which it appears to be curling and uncurling. This writhing is an exaggerated version of the undulation used in surface locomotion. More muscle power is recruited, and the rate of ascent is roughly twice that of side-to-side climbing. The drawback is that the lifeline must be transferred from the thoracic legs, down the abdominal legs, and ultimately to the claspers at the end of the body, a risky maneuver. This technique may be a specialization in tent-dwelling caterpillars, allowing for the quickest possible return. The caterpillar that has ventured out of the tent may have temporarily escaped a predator by spinning down, but it will be even safer when it is back in the communal tent.

Once a climbing caterpillar makes contact with the ground or with a branch or leaf other than the one from which it parachuted, it may choose to remain there, at least temporarily, using its claspers, or it may disengage from the line and shuffle or loop back to its home leaf or tent. My measurements showed that the holding force of the claspers is greater than the breaking force of the lifeline. This benefits the caterpillar: once its claspers grip a solid surface, the larva will not be wrenched back into space by winds blowing against the lifeline and can thus avoid another climb up a rope.

A lecturer in the Department of Anatomy at Cambridge University, John Brackenbury is currently researching animal locomotion and vision and insect pollination ecology.



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Mongolia: Ou

Story by Sherylyn Briller
Photographs by Antonin Kratochvil; Saba Press Photos

On the outskirts of Ulaanbaatar, Mongolia's capital, the old Russian car—carrying two children, one of their teachers, and me, the anthropologist—chugged up a steep hill. Most of the buildings around us were the traditional nomad houses known as *gers,* made of folding frameworks and felt coverings. As we neared a modern shelter with several adjacent *gers,* the fourteen-year-old boy in the back seat stood up and excitedly yelled, "That's my new home!"

For Dorj (not his real name), who had spent three winters living outdoors in subfreezing temperatures, 1997 was proving to be a good year. His previous home had been a sewer near the railroad station. He had earned money shining shoes by day and had tried to keep warm near some hot-water pipes at night.

Street children are a new phenomenon, fallout from the economic crisis precipitated by the collapse of the Soviet Union.

t in the Cold

Dorj originally came from a small town in the countryside. His parents were divorced when he was four, his father left home, and Dorj lived with his mother and three younger siblings until age eleven, when he ran away with some friends to the provincial capital city. From there he and his friends took the train to Ulaanbaatar, "because it seemed interesting to come to the city." Recently Dorj had tried to contact his mother and siblings, but was told that they, too, had moved to Ulaanbaatar. He was not able to locate them.

In December 1996, police in Ulaanbaatar began implementing a new national policy of picking up street children, bringing them to an identification center, and attempting to reunite them with their families. Since Dorj's family could not be found, he was placed in one of the shelter programs that have been set up in suburban *ger* communities.

Mongolia's street children are a new phenomenon,

fallout from the economic crisis precipitated by the collapse of the Soviet Union. In a culture where children are traditionally treasured and to be childless is considered devastating, the existence of street children is a source of anguish. As Tselmaa, a seventy-year-old pensioner told me, "When I see these street children on the television news, I always start crying, because some of our children are really hungry now and in very bad condition. We only have two million people in our country and we must protect these children, who are Mongolia's future, from starvation."

Heir to the empire founded by Genghis Khan in the thirteenth century, ruled by the Manchus from the seventeenth until the early twentieth century, Mongolia was traditionally a herding society built upon strong kinship ties. The survival of livestock throughout the year, especially the harsh winter, depended upon the efforts of all family members. Generally, men were in charge of herding larger animals and taking them farther from the campsite to graze, and women were responsible for herding smaller animals, milking, processing and preparing food, and maintaining the *ger.* Even small children helped with herding, often looking after the young animals. Large families were considered desirable because many children insured extra household help and security in old age. (Although norms regarding family size are changing today, the country is so sparsely populated that some still believe it is advantageous to have "as many Mongolians as possible.")

Unlike their counterparts elsewhere in Asia, Mongolian women traditionally enjoyed fairly high status and freedom, but the kinship system was patrilineal

Books to Read

The Land and People of Mongolia, *by John S. Major (HarperCollins, 1990)*

The Changing World of Mongolia's Nomads, *by Melvyn C. Goldstein and Cynthia M. Beall (University of California Press, 1994)*

Mongolia in Transition: Old Patterns, New Challenges, *edited by Ole Bruun and Ole Odgaard (Curzon Press, UK, 1996)*

and that meant sons customarily established households in a common camp with their fathers. This camp, consisting of some two to seven households, was known as a *khot ail* and was a way of pooling labor for herding. It functioned as a social safety net for households that lacked adequate labor resources, and it minimized risk to the group in the event of a natural disaster, such as a heavy snowfall that necessitated the quick sheltering of animals. Poor families received loans and exchanges from others in the *khot ail,* including small amounts of flour, salt, and tea on an almost daily basis.

In 1924, Mongolia became a socialist country. The initial attempt to reorganize the herding economy failed, but herding collectives were established after World War II. Renamed the *suur,* the *khot ail* was preserved to some degree as a production and living unit.

Four out of five street children suffer from chronic health problems, often the effect of malnutrition. The psychological damage is harder to measure.

The unit consisted of two to three families and, at least officially, was removed from a kin basis. In most other respects, Mongolia's political and economic systems were modeled after those of the Soviet Union, which provided major economic and technical assistance for rapid industrialization and urbanization. A mix of industrial activities, sedentary livestock production, and farming supplemented the pastoral economy. People from a growing rural population were encouraged to migrate to the cities, and by 1990, 57 percent of the population lived in urban areas.

Communism also brought with it an elaborate system of social services. Poverty was rare, and all citizens had access to health care, education, and pensions—benefits that were heavily subsidized by the Soviet

Union. When the economy and political structure of the USSR began to disintegrate in 1987, Mongolia lost this aid, as well as accustomed patterns of foreign trade.

A peaceful democratic movement that began in 1990 resulted in the emergence of multiple political parties and the creation of a free market economy. Further industrialization by the state nearly stopped, agricultural enterprises were largely privatized, and large numbers of urban people began returning to rural areas to herd animals. While some entrepreneurs prospered, many families began to experience hardships during this transition period. Urban areas have been hit especially hard by increasing poverty, unemployment, and inflation, as well as by the declining welfare system and by limited and costly energy supplies. A 1995 survey by the State Statistical Board of Mongolia and the World Bank revealed that 828,000 people—more than one-third of the national population of 2.3 million—were living below the poverty line. With nearly 40 percent of the population under fourteen, children are among the most deeply affected.

In July 1996, the National Children's Center reported that there were 2,700 street children, but some unofficial estimates now place the number between 3,000 and 4,000. Of these, some 70 percent spend their days on the street working to supplement their

They ride the train into the capital—seeking employment, adventure, or escape from broken homes.

Organizations to Contact:

Childhope International, *founded in 1986, collaborates with UNICEF to address the special needs of street children worldwide. For information, contact childhope c/o U .S. Committee for UNICEF, 333 E. 38th St. New York, NY 10016 tel. (212) 983-1422 fax: (212) 779-1679*

Save the Children Fund (UK), *17 Grove Lane, London, SE5 8RD, UK tel. 171-703-5400 Web site: http://193.128.6.150 /scf/index.html*

UK Committee for UNICEF, *55 Lincoln's Inn Fields, London, WC2A 3NB, UK tel. 71-405-5592 E-mail: info@unicef.org.uk*

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families' incomes but still go home at night. These children earn money by selling juice or newspapers, by portering, or by illegal means, such as pickpocketing and prostitution. Another 25 percent of street children work full or part time on the street only in summer, but live with their families in the wintertime. The final 5 percent, at least 150 to 200 children by these estimates, have no contact with their families; some have lived on the street for as long as six years.

Dorj and most of his friends don't like to talk about the time when they lived outside, near the railroad station. About twenty children made up the local gang. Erdenet, a gregarious twelve-year-old-boy, described what their life was like:

> *We had a leader and he was the boss. He was eighteen or nineteen years old. He'd been on the street for a long time and was very tough. He had done a lot of things, but I don't know what all of them were. He could tell you what to do, and if he didn't like how you did it, he could beat you. That's kind of like how it was at home also. There's no way you could live in that area without belonging to the group. You had to always give at least some of the money that you got and maybe some of the clothes and*

things that you came with. We sometimes split the bread or cigarettes we got. Kids who worked hauling stuff in the market might also have extra food from being there. Sometimes we shared other things, especially with the younger children because they were crying from hunger all the time and from being lonely. After a while, these other kids kind of seem like family for you—they remind you of your younger brothers at home.

Most street children are between the ages of eight and fourteen, although one that I saw staying in a shelter was only three years old. Boys often leave home earlier and as a result account for two-thirds of this population. About 80 percent of street children in the capital come from the capital or provincial cities along the railway corridor. Many ride the train into Ulaanbaatar and simply never return home. They seek employment, adventure, or escape from broken homes (some, facing parental alcoholism and abuse, would rather cope with the hardship of the streets).

Many children whom I met told me that they are on the street today because of their families' worsening economic condition. Oyuntsetseg, a thirteen-year-old girl who lives in Ulaanbaatar's largest shelter for children, explained, "My mother could not care for me and my two younger siblings because there was no money or relatives who could help, so she brought us here three years ago. I know that my mother loves me because she still comes to visit sometimes. I wish that there was enough money for us to live at home because it is really hard to be separated from your family."

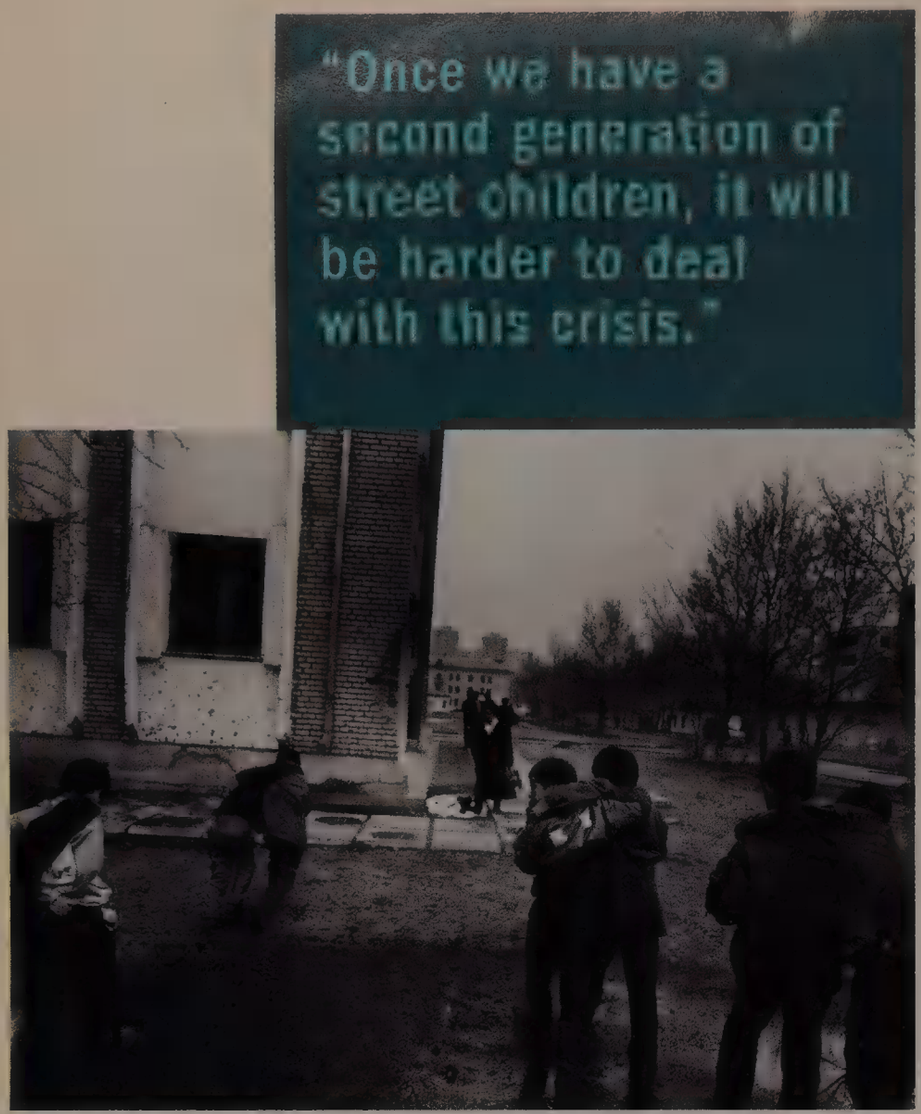
The physical effects of living on the street are already taking their toll on these children, who are reported on average to be three to four inches shorter and to weigh 16 to 32 percent less than their peers. More than four-fifths of street children have chronic health problems, often the effect of malnutrition, including skin diseases and respiratory problems. The psychological damage these children have suffered is harder to measure.

Under Communism, family conflict and parental neglect were problems addressed by the educational system and the state organizations for which the parents worked. Today, a number of government and private agencies are stepping in to provide the needed support. Their first goal is to reduce the number of street children through preventive social service programs and through reuniting families when it is still possible. Children who have no parents or whose parents cannot provide adequate care are placed in state or private shelters, where they can live temporarily or until the age of sixteen.

Apart from basic care, authorities seek to provide educational opportunities and vocational training. As Ms. Enkhtsetseg, deputy director of the National Children's Center, commented, "These children are able to learn, and they need the social interaction of going to school with other children." The youngest children living in state facilities can begin to study in regular nursery and primary schools with their peers. For the older children, some special programs are required, as many have never been to school and it is too humiliating for them to be placed in classes with much younger children. A goal in the capital is to enroll children in their local community schools, so that if they return to live with their families, they can continue to attend the same schools. Relocating children from provincial districts is more difficult, although officials are being urged to take responsibility for street children from their localities.

"Now I am learning to read and to be a carpenter; it is hard to imagine returning to the street."

Dorj's program is underwritten by Save the Children Fund (United Kingdom), which administers it in collaboration with several local government children's social service agencies. The project provides basic



housing, fuel, and food for the children to prepare their meals. The children live in residential groups, each consisting of a small building and several *gers,* an arrangement reminiscent of the *khot ail.* The children are responsible for getting water, splitting wood, and other tasks. At the time of my visit, several teachers were rotating their hours to provide adult supervision and assistance, as well as schooling and vocational training. Most of the children are dropouts or have never been in school before.

Dorj invited me to see his new home, a residential cluster called the Rik House, where eight boys and five girls, ages eleven to seventeen, make their own household rules and handle everyday chores. Before entering the main building, he stopped to have a cigarette because the children had decided not to allow smoking inside. While having his smoke, Dorj told me that when he was first picked up by the police, he was afraid that he would be treated like a criminal because, like other members of his railway-station-based youth gang, he had no address or identification papers. "We were all scared, but they treated us nicely and then brought us here." Since these children already knew each other, setting up this experimental, self-managed household was fairly easy, although according to the teachers, new kids have a harder time moving in and some of them have subsequently run away.

Every day, Dorj and the other children get up at 8:00 A.M., make a fire, and prepare morning tea. After breakfast, teachers give them lessons. Dorj proudly showed me his notebook, in which he is practicing writing the letters of the alphabet. From lunch until 4:00 P.M. come other lessons, including vocational training. In the evening, the children do household chores, after which they can relax and listen to music on a donated stereo. Most of these children, as well as those I met who were in other shelter programs, were enthusiastic about having a place to live. As Dorj said, "After staying for a week, no one wants to live outside anymore. Now I am learning to read and training to be a carpenter, and it is really hard to imagine ever returning to the street again."

Unfortunately, because of the nation's continuing economic crisis, keeping community projects going after they are launched can be hard. For example, in 1995 the Songinokhairkhan District of Ulaanbaatar initiated a small business project to assist twenty-five local street children in selling their own cookies in the community. Supplies were purchased wholesale from the food market, and the children baked their products in a local nursery school kitchen. With increasing inflation, however, people could not afford to buy the cookies, and the nursery school could no longer pay the increased electricity bill. Also, some people complained that the street children who were selling the cookies were dirty, and that made buying their products unappealing. The project ceased to operate by 1996. This year no government funding will be available for supporting community-based projects. And, as I recently learned, Dorj and the other children in his shelter program may lose their teachers for lack of funding.

What must be done, ultimately, is to improve poor families' standard of living enough so that their children are not forced out onto the street. "The situation of street children in Mongolia is really different from that of other countries, where since birth some children have never had anything," observes Ms. Oyunbileg, of Save the Children Fund (UK). "Until a few years ago, Mongolian street children were all living in families like ordinary children. We must not waste any time now, because once we have a second generation of street children, it will become much more difficult to deal with this social crisis." □

Brazil: Mov

Despite progressive legislation, children continue to live—and to die—on Brazil's city streets.

Story by Nancy Scheper-Hughes and Daniel Hoffman
Photographs by J. L. Bulcao; Gamma Liaison

In the 1960s ubiquitous street urchins in Brazil were referred to with a blend of annoyance and affection as *moleques,* meaning ragamuffins, scamps, or rascals. *Moleques* were streetwise, cute, and cunning, sometimes sexually precocious, and invariably economically enterprising. The *moleque* was an amusing enough popular stereotype that an ice cream bar, chocolate-covered and flaked with "dirty" bits of coconut and almonds, was later named the *pé de moleque,* "ragamuffin's foot." *Moleques* tried to make themselves useful in myriad ways, some bordering on the criminal and deviant. Think of Fagin's boys in Dickens's *Oliver Twist,* especially the Artful Dodger, and you have it. Shoppers would slap their heads in exasperation when a nameless scamp they had hired to carry home a market basket on his head made off with their watch in the quick final transaction. While the victims of a *moleque*'s street tactics might alert local police and the boy might be

ing Targets

found—perhaps beaten by a police officer or sent to a state-sponsored reform school—there was no sense that street children as a class were a pressing social problem against which certain interest groups (homeowners, shopkeepers, business people) should aggressively organize. Instead, they were seen as a potential source of cheap domestic or agricultural labor.

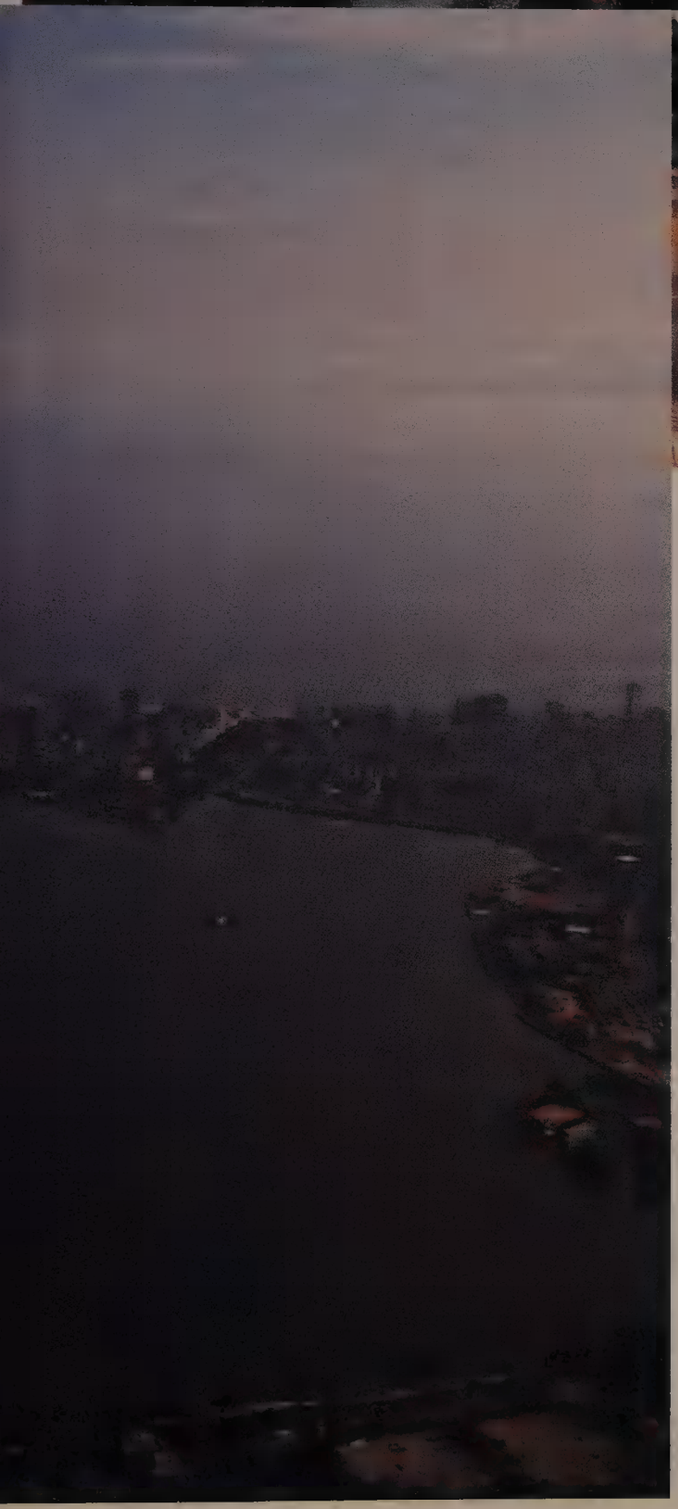
In the Brazil of the 1990s, however, poor children on the loose are more often viewed as a scandal, a public nuisance, and a danger. This shift is reflected in the stigmatizing terms by which the children are now known. Yesterday's cunning *moleque* is today's *pivete* (young thief), *trombadinha* (pickpocket, purse snatcher) and *maloqueiro* (street child, thief). (Ours is a perspective informed by more than thirty years of intermittent anthropological fieldwork in the interior sugar plantation market town of Bom Jesus da Mata in the state of Pernambuco, and more recently in the cities of Rio de Janeiro, São Paulo, and Recife, as well as contact and communications with children's rights activists.)

Street urchins have long been a feature of urban life in Brazil, as elsewhere in Latin America, where chil-

dren are simultaneously drawn to, and in flight from, different kinds of labor. But in 1981 Hector Babenco's film *Pixote: a lei do mais fraco (Pixote: The Law of the Weakest)* stunned audiences with its savage images of the lives of marginalized children both on the streets and in detention. Filmed during the final stages of the military dictatorship in Brazil, *Pixote* focused on a child in the generation left behind by the failed "economic miracle" of the 1970s. Rapid industrial expansion made Brazil into the world's eighth strongest economy, but one whose wealth was more unequally distributed than in any other modern, industrialized nation.

The country's much-vaunted move to democratization was especially hard on street children. The authoritarian police state that had ruled Brazil for twenty years had kept the social classes safely apart, with "dangerous" poor children confined to the *favelas* (slums) or in prisonlike reform schools. But with the transition to democracy in 1985, the shantytowns ruptured. Poor black street children descended from hillside slums and seemed to be everywhere, flooding downtown boulevards and *praças* (plazas), flaunting their misery and their needs. Children who in the 1960s might have been viewed with mild annoyance were now feared and

Estimates of Brazil's population of street children vary from tens of thousands to millions.



often became targets of violence and even murder.

Perhaps the very process of democratization (accompanied by economic austerities imposed by the World Bank's model of development through "structural adjustment"), occurring in the absence of economic and social justice, provoked a crisis for street children. Not only had they become part of a more visible, desperately poor population, but new democratic laws and liberal institutions now promised them civil rights protections that used to be the province of the affluent and the educated. Many middle-class Brazilians felt insecure, unprotected, and threatened by these newly empowered children. Paradoxically, vigilante and police-linked violence increased during and following the transition from military to democratic politics, with children included as targets.

The crisis has been complicated by a lack of precision regarding the numbers of street children, the nature of their existence (alternating between home and street), and the number of crimes committed by and/or against them. Estimates of their population vary from tens of thousands to millions. In São Paulo alone, survey estimates vary from as low as 5,000 to as high as 500,000, depending in part on whether they include those children who have homes but spend most of the day and occasional nights on the streets.

In a 1989 interview, a group of boys who survived by begging on the streets of Bom Jesus da Mata discussed public perceptions of them. "They say we will turn into thieves," said nine-year-old Josenildo. Marcelo, two years older, broke in with, "Thanks be to God that up until now I have never stolen anything, and I never want to either!" The quietest and most reflective of the group, ten-year-old Adevaldo (nicknamed Deo), said, "We do become thieves. But I myself am going to be different. I am going to return to school until I am graduated and then I will find a good job. I am going to have a wife and children and I will never put any of them out in the streets to beg."

To survive, children sell candy, guard and wash cars, carry groceries, and shine shoes.

"And where do you hope to find a job, Deo?"

"I want to work in the Bank of Brazil," he replied proudly, to laughter all around.

"Do you think they will trust you in a bank, Deo? Won't they say, 'Oh, I remember him; wasn't he the one who used to beg outside the Santa Terezinha bakery?' "

"But I am going to quit soon, and no one will remember me. I am already looking for a job, but the woman who said she would hire me has changed her mind. And now I only beg because I am hungry."

"When you go home, isn't there food for you?"

"My mother only cooks for my father, not for me."

"Doesn't your mother care for you?"

[After a slight hesitation] "She likes a part of me."

"Which part?"

"That I sometimes bring home things for her that I get in the street."

"You mean that you steal?"

"Yes, sometimes. But I don't like doing these things and I want to 'reform.' "

Casa and *rua,* "house" and "street," are keywords in Brazil that refer to more than physical spaces. The terms are moral entities, spheres of social action, and ethical provinces. *Casa* is the realm of relational ties and privilege that confers social personhood, human rights, and full citizenship. *Rua,* in contrast, is an unbounded, impersonal, and dangerous realm, the space of the masses (*o povo*). Shantytown homes are overcrowded and families often unstable. Consequently "home," especially for boys, is not so much a place to eat and sleep as an emotional space, the place where one comes from and where one returns, at least periodically. As denizens of the street, poor and semiautonomous children are separated from all that can confer relationship and propriety, without which rights and citizenship are impossible. Yet, while street children may be almost autonomous, they often remain emotionally dependent on home and deeply attached to the idea of family. When we asked nine-year-old Chico, a street boy of Bom Jesus da Mata, if his mother still loved him, he replied without hesitation, "She's my mother, she has to love me!" But Chico knew as well as we did that his mother had tried several times to give him away to distant relatives when he was a baby and had later forced him out of the house.

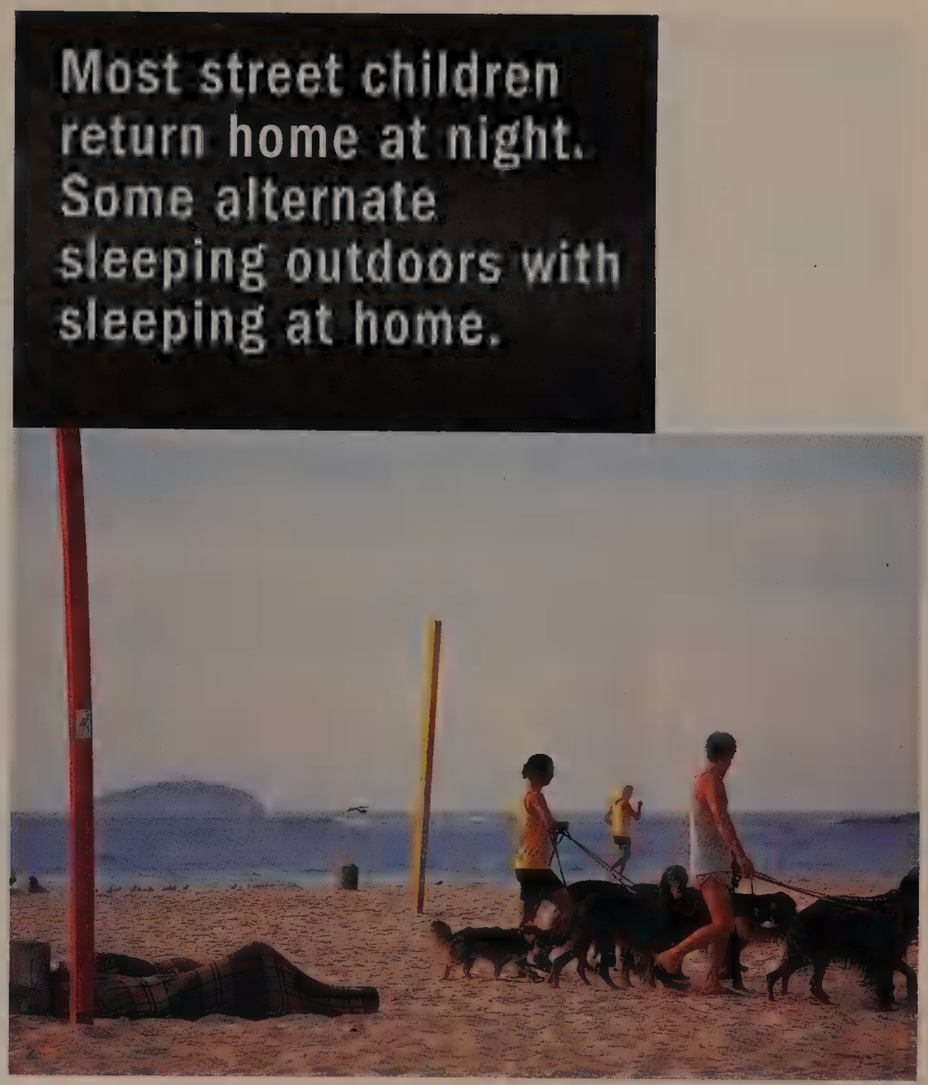
From the point of view of shantytown dwellers, nothing is extraordinary or problematic about its children flowing onto the streets, for the streets, especially in the city center, are primary sites of employment and

economic survival for both poor children and adults. The term "street child" is not even used in the shantytowns; parents sometimes do speak critically of local boys and young men, *malandros,* who "spend their lives doing bad things on the street." Perhaps the closest that people in the shantytowns come to thinking of a street child is the oft-expressed fear of "losing" a child to the streets, to the uncontrolled realm beyond the home.

Like Chico, most street children work. They sell candy or Popsicles, guard and wash cars, carry groceries, and shine shoes. The outward signs that a child is working—the shoeshine box, the tray of candy, the pail of roasted nuts—signify that the child is "good" and should not be perceived as a threat. The empty-handed street child, traveling in a group and obviously not working, is far more likely to suffer discrimination. Most children return home at night to sleep, while a minority alternate sleeping outdoors with sleeping at home. An even smaller group lives full-time in the streets. This smallest group, truly homeless and very visible, fuels the negative stereotypes of dangerous and uncontrollable street children. Commonly associated with theft, gang life, and drugs, they are the most likely to be targets of exploitation and of violence that includes police brutality.

The most notorious assault on Brazilian street children, one that renewed international concern for their plight, was the Candelária massacre of July 23, 1993. On that night a group of off-duty policemen opened fire on more than fifty children who were sleeping in the elegant square in front of Rio de Janeiro's Candelária Cathedral. Eight died, six on the spot, and two at a nearby beach, where they were taken and killed execution-style. Many others were wounded. Opinion polls showed considerable public support for the police action. Many "ordinary" citizens reported being "fed up" with the criminal and disorderly behavior of street children. Rascally *moleques* truly had been transformed into dangerous *meninos de rua* (street children).

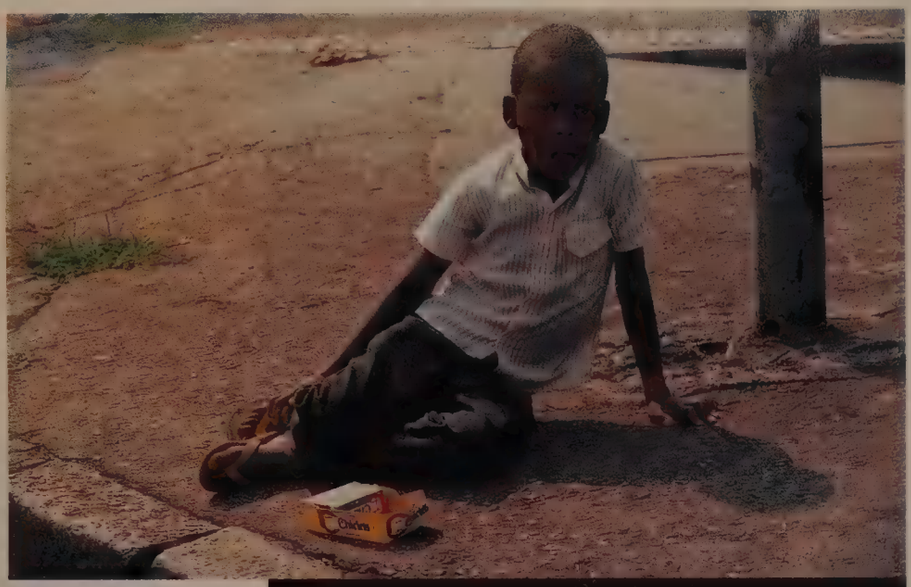
In the past decade a new fear has been added, that of untimely death at the hands of paid death squads. Beginning in the 1980s—well into Brazil's democratic transition—reports surfaced of a deadly campaign against street children involving kidnapping, torture, and assassination by paid vigilantes and off-duty police recruited in projects of "urban hygiene." They seemed to operate with relative impunity, especially in large cities. But even in small interior towns such as Bom Jesus da Mata, street children live in daily fear of police, state institutions, kidnappers, and, more fantastically, people who are rumored to steal human organs. Between 1988 and 1990, close to 5,000 street children



and adolescents were murdered in Brazil, but few of these homicides were deemed worthy of official investigation. This lack of bureaucratic attention is not surprising when police officers are among the suspected perpetrators. Most of the victims were males fifteen to nineteen years old, although younger children were also victims.

In his 1991 denunciation of violence, *Brazil: War on Children,* journalist Gilberto Dimenstein identified the role of off-duty policemen and hired killers—working in concert with small businessmen and shopowners—in sustaining the death squads. Street children were said to be bad for business and for tourism, threats to public health and safety. A report by the São Paulo chapter of the Brazilian Bar Association implicated military police in death squads funded by shopkeepers that killed most of nearly 1,000 street children who were slain in that city in 1990.

The vast majority of full-time street children do not so much run away or "choose" the streets as they are thrown out of, or driven from, homes where exposure to chronic hunger, neglect, and physical or sexual abuse makes life under bridges, in bus stations, and in



The tray of gum or candy signifies that the child is "good" and is not a threat.

public rest rooms seem preferable, or even—as one child living in an abandoned building in Bom Jesus da Mata put it—more "peaceful" and "happy" than life at home. Those who live on the streets full-time are mostly boys, although girls are also forced there, often following escape from exploitative work as domestic servants or as child prostitutes in cabarets. For some girls, however, the reverse is true: they may seek out prostitution, believing it provides a "safe house" away from the anarchy of the streets.

Rumor plays a significant part in justifying discrimination against these children. In the May 29, 1991, issue of *Veja*, a weekly magazine, it was reported that the street children who congregate in the Praça de Sé, the central plaza of São Paulo, commit more than 32,000 thefts and robberies a year, that is, about three thefts a day by each child. The sources of these statistics were vague. In 1992 newspapers and radio carried reports about roving gangs of shantytown children, some of whom were said to stream across the southern beaches of Rio de Janeiro, robbing anyone within reach. These reports were based on a single incident later attributed to youths from a particular slum, none of whom were homeless. Nonetheless, the stories caused considerable panic in middle- and working-class people, fearful of new "invasions" of the desperately poor into their social spaces.

It's true that some street children, especially older ones, survive, at least in part, through petty crime. However, Padre Bruno Secchi, a Salesian missionary who has been working with the poor and street children for thirty years in the Amazonian city of Belém, contends that what is striking is not how many poor children are criminals but, considering the misery of their lives, how few resort to crime. Many survive by begging, but as soon as they show signs of physical maturity, they cease to evoke compassion. Seventeen-year-old Marcos Julio spent nine years living on the streets of Bom Jesus da Mata. He said that as long as he was "little and cute" he could make his way by begging, but after he turned about fourteen, people suddenly became afraid of him and chased him away.

Exchanging sex for food and affection is also a survival strategy, especially for boys who were initiated into sex at an early age. And for young girls escaping from the "slavery" of domestic service, prostitution can seem like liberation. "The first time I sold my body was the first time I felt like it really belonged to me," a teen-age girl confided at a meeting for young sex workers in São Paulo, organized by an AIDS awareness group. The girl, who had run away from Pernambuco, had a family history that included incest.

Glue sniffing is another badge of street identity, along with sniffing perfume, gasoline, or shoe polish. In Bom Jesus da Mata, children as young as eight years old explained that glue was pleasant (*bom*) and smelled nice (*cherioso*). Some said that it helped them to sleep, especially when hungry. Pedro, age twelve, described himself as nervous and emotional. He said glue sniffing made him more calm. For some small children, it was used interchangeably with thumb sucking or pacifier sucking, practices that street children (as well as other children in the shantytowns) sometimes engage in as late as adolescence.

During the military years (1964–85) the primary mechanism to control loose and wayward children was FEBEM, the State Federation for the Well-being of Minors, a network of reform schools that were often jail-like and inspired fear in shantytown children. ("You won't ever turn me in to FEBEM, will you?" street children often nervously asked Nancy during the military regime years.) But even after the passage of new laws designed to reform these institutions, real change has been slow, and in many small municipalities like Bom Jesus da Mata, local jails have replaced the reform schools as "holding tanks" for dangerous and endangered youth. During fieldwork in 1992, we met

Books to Read

Brazil: War on Children, *by Gilberto Dimenstein (distributed by Monthly Review Press, 1992)*

Death Without Weeping: The Violence of Everyday Life in Brazil, *by Nancy Scheper-Hughes (University of California Press, 1993)*

Children and Urban Poverty in Brazil: Street and Working Children and Their Families, *Innocenti Occasional Papers, The Urban Child Series (UNICEF, 1992)*

Final Justice: Police and Death Squad Homicides of Adolescents in Brazil, *by Ben Penglase (Human Rights Watch/Americas, 1994)*

several underage youths locked up alongside adult offenders in Bom Jesus da Mata's small, dingy municipal jail. Some of them had been there for periods ranging from several weeks to six months with no clear indication of just when they might be tried or released. A local judge explained that these boys were at risk of retaliatory attacks by other children and by paid vigilantes. Without relatives to claim or protect them, with the FEBEM mandate curtailed under new laws, and in the absence of a formal network of foster homes, jail seemed the only reasonable option.

Decisions about the fate of individual street children are made in the context of a deep national preoccupation with the country's future. So many factors feed public fears—chaotic urbanization, the AIDS epidemic, and the political liberalization that provided new legal protections for the poor, homosexuals, and the sick or disabled—that it is increasingly difficult to remove or incarcerate "unwanted" populations legally. At the same time, Colombian cartels and the Italian Mafia, trafficking in cocaine, brought upscale firearms into the shantytowns and distributed them to youths and even to street children, whom they also recruited as messengers. The expansion and reorganization of crime in the shantytowns interrupted and confounded the growth of participatory democracy that so many grass-roots organizations—residents associations, trade unions, and local church communities—had long struggled to introduce.

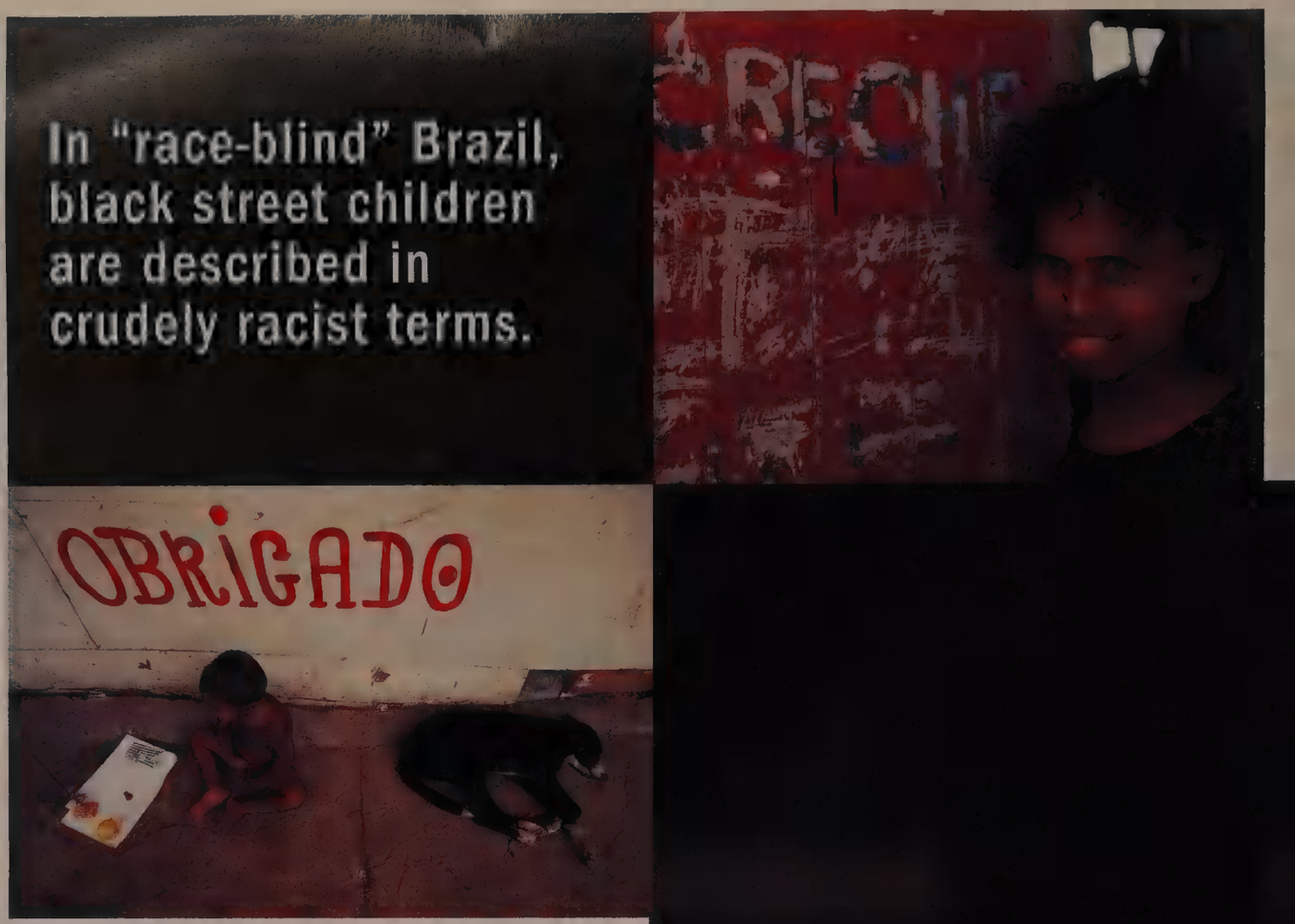
A classified document produced at Brazil's Superior War College in 1989 played on people's fears:

> *Let us suppose, for the sake of argument, that there are some 200,000 unattached minors (which is a conservative estimate). By the beginning of the next century we will have a contingent of criminals, malefactors, and murderers the size of our current army. . . . At that time, if police lack the means to confront such a situation, the constituted executive, legislative, and judicial powers could request the co-operation of the armed forces to take on the difficult task of neutralizing them [that is, "destroying them"] in order to maintain law and order.*

Something like this is already happening. In November 1994, soldiers, backed by tanks and helicopters, were used in a crackdown on crime in Rio de Janeiro shantytowns. According to Human Rights Watch, the first victims included young people caught in the crossfire. Paradoxically, shantytown dwellers strongly support various police actions against their own populations, according to opinion polls. What makes people there assume that violent attacks on them and their children are an acceptable form of social control, the legitimate "business" of the police? For one thing, the very ubiquity of violence against the poor makes them view their own violent deaths as predictable, natural. There are also racial undertones to the "normalization" of police and vigilante attacks on people in the shantytowns. The crimes of the poor, the petty thievery of older street children, are viewed as "race" crimes and as "naturally" produced. Poor, young, unemployed blacks are said to steal because it is "in their blood" to do so. They are described in crudely racist terms as *bichos da Africa,* "animals from Africa." Increasingly today, race hatred and unconscious racism have emerged as explanations for popular support of violent and illegal police actions in shantytowns and on the street. Indeed, the subtext of the discourse on street children is color-coded in "race-blind" Brazil, where most street children are black. Of the more than 5,000 children and youths murdered between 1988 and 1990, most of the victims were black males between the ages of fifteen and nineteen years.

Fundamentally, Brazil's street children are poor children in the wrong place; as long as they remain in the shantytowns, they are not viewed as an urgent problem about which something must be done. But by

Perhaps the process of democratization itself provoked the crisis for street children.



"invading" the city centers, frequenting upper-class beaches, and engaging in petty crimes against the middle class, they defy the segregated order. The wealthy retreat into private enclaves with private schools, private security, and private transportation, and the public sphere is abandoned to its own turmoil: lack of security, paucity of resources, and vigilante justice. The risks and hazards for street children are great: illiteracy, toxicity from inhalant drugs, chronic hunger and undernutrition, sexual exploitation, and AIDS.

Although the overall picture is not encouraging, there are hopeful signs. In the past decade, a large social movement on behalf of children's rights has arisen, involving thousands of individuals and many small grassroots groups. They have organized street youth in the cities, exposed routine violence and assassinations, advanced constitutional reforms and legislation, and defended the right of children to be *in* the street, while recognizing that a life *of* the streets can only be self-destructive in the long term. Despite the backlash against its liberal reforms, the new Brazilian constitution (1988), and particularly the *Estatuto da Criança e de Adolescente* (the Child and Adolescent Statute), which became law in 1990, are remarkable documents. The child statute—the result of intensive lobbying by a broad coalition of nongovernmental organizations and

Organizations to Contact

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Human Rights Watch,
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#910, Washington,
D.C., 20005
tel. (202) 371-6592
fax: (202) 371-0124
E-mail:
hrwatchdc@igc.apc.org

activists—radically transformed the legal status of children and redefined the responsibilities of the state and civil society. But as enviable as the new laws are, they have not yet been claimed by the majority, nor have they become internalized popular standards and everyday practice in Brazil. They remain elusive ideals that are daily subverted by those who regard the lives of poor children as undesirable and expendable.

Brazil's street children have challenged and redefined the boundaries between public and private, adult and child, normal and deviant behavior. Because they violate conventional ideas about childhood innocence, vulnerability, and dependency, they are seen not as children at all but as dangerous young people in revolt. The choices offered such children at present are extremely limited: to return home to their "proper" childhoods—which is not an option for most—or to accept the risks of a semiautonomous life on the streets. The true test of Brazil's democracy will be the nation's ability to think of childhood and citizenship in radically new ways. Will it be possible for street children—who cannot depend on nuclear families for support—to find protection, rather than bullets, on the elegant streets of modern Brazil? □

On the Streets

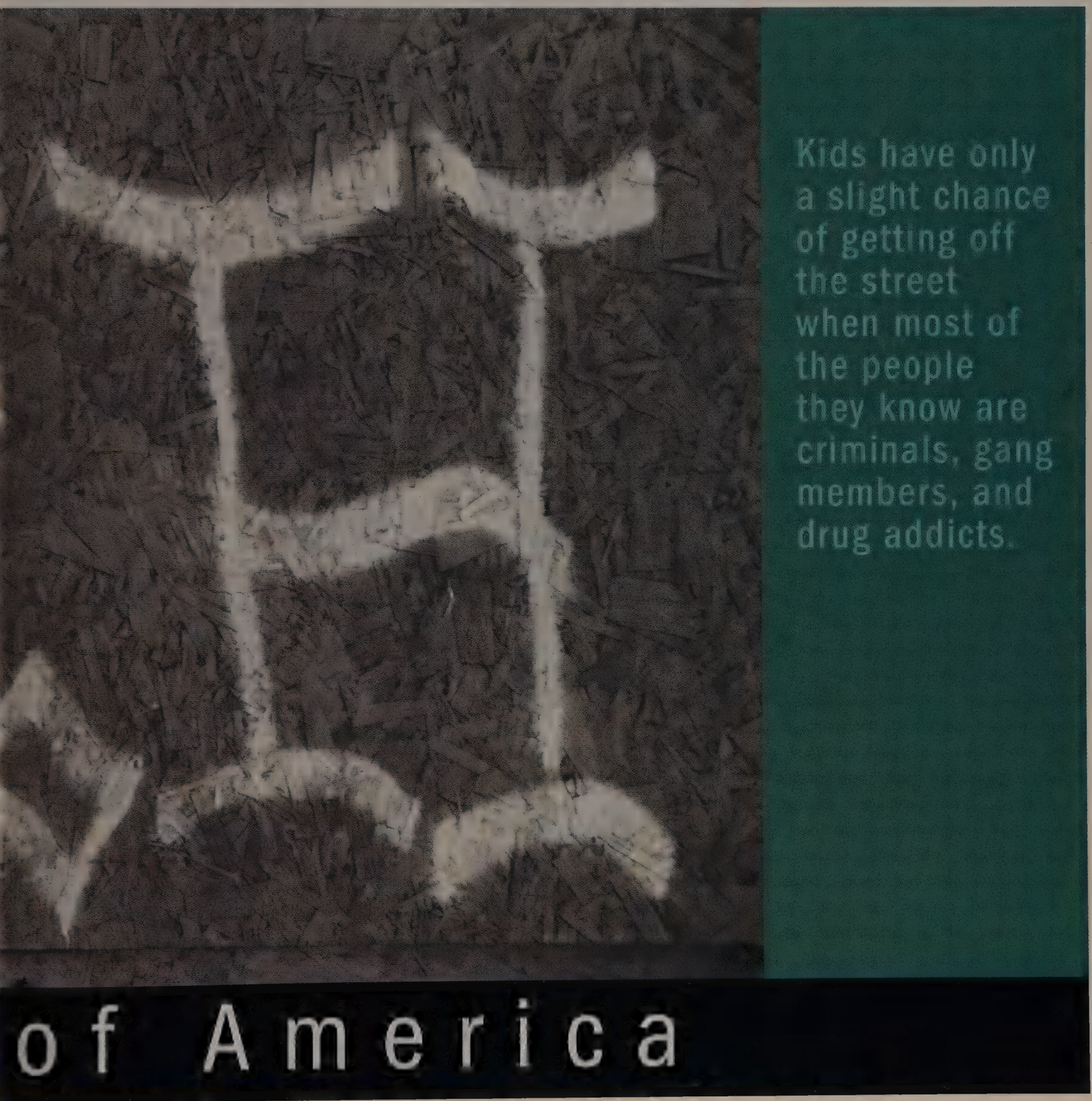
Story by Mark S. Fleisher
Photographs by Eugene Richards

Riddled by pellets from a 12 gauge shotgun, a broken street light fixture lies atop debris at the side of the street. "About seven last night, a guy fixed it and put in a new light," says Rick (pseudonyms are used), a member of a youth gang known as the Fairview Hawks. "And now look at it." He points to the thick shards of glass next to the light pole where the lamp once illuminated a segment of Fairview, a narrow, north-south street traversing rolling hills in a residential area of a midwestern city.

A working-class neighborhood, the Fairview district consists of small wood-frame houses nestled under the branches of old trees. Although less than ten minutes from major freeways to the east and the downtown businesses to the west, this area has virtually no

condominiums, strip malls, movie theaters, or restaurants—no white-collar families that support urban growth. Except for the police, utility workers, and letter carriers, few outsiders cruise up and down Fairview. In part that's because the Fairview Hawks loom over the physical and social landscape. The gang consists of some seventy blacks, whites, and Latinos, about three-fourths of them male, ranging in age from the early teens to early twenties.

Fairview Hawks control an area of about ten square blocks between 57th and 61st streets, which run east–west. "The corner of 60th and Fairview is ours!" asserts G-Love, who by virtue of her age (nineteen) and her status as a founding member has assumed the informal role of one of the gang's leaders. Like gangs, or "sets," in other urban and rural areas, Fairview Hawks demark their territory with graffiti and protect it with violence. Spray paint on houses, garages, side-


Kids have only a slight chance of getting off the street when most of the people they know are criminals, gang members, and drug addicts.
of America

walks, and driveways all around the neighborhood are signs of ownership: "FH" for Fairview Hawks and a dollar sign, which indicates a love of money. Green is the Fairview Hawks' color. "I love money, and money's green," says G-Love.

Even though they are engaged in unlawful activities and have been called a gang by outsiders, the Fairview Hawks don't think of themselves that way. "We're a family," says seventeen-year-old Poodle (sometimes known as Poodle Bitch, because of her occasionally irascible temperament). "We ain't no gang," asserts fifteen-year-old Renée. "A clique, that's what we are. I call us a cliquilation." She smiles, proud of her linguistic creativity.

And certainly the Fairview Hawks are not an example of a drug gang, a group of street criminals (most often adults with criminal histories) whose main enterprise is to sell drugs and who use violence to protect or expand their drug-selling territory. Instead, this type of gang fills the social needs of its members, whose early family lives left them alienated, emotionally unstable, and without educational aspirations.

The Fairview Hawks formed a few years ago, partly to counter harassment from North, a gang from the city's north side. G-Love says she and Fat Sal, TJ, Buck, Sweet Pea, and Frosty were sitting on her front porch and decided to transform themselves from a bunch of neighborhood kids into a clique with a color and graffiti. Others soon joined. About twenty members get together every day; Caramel, eighteen, calls this the "everyday group." But on weekend nights and at times when Fairview Hawks experience trouble from other gangs, the group expands quickly.

Many Fairview Hawks started out as members of other city gangs. "Everyone's chillin' with their own set, but they're down with Fairview," says Caramel, who—along with G-Love, Afro, Brawn, and Vinny—held membership in various Crip sets. Others, including Ann, Chucky D, Jenny, Lucky, and Green Bean (he's tall, thin, and wears green clothing) were Latin Counts. Most gangs in the city categorize themselves as Crips or Bloods, using gang names that originated in Los Angeles about 1970 and spread around America. The names are often used by youngsters who have no knowledge of, or social affiliation with, the Los Angeles originals. The two types of gangs are customarily archenemies, but Fairview Hawks who identify themselves as Crips or Bloods get along well, by virtue of sharing a neighborhood and growing up together (many of them are brothers, sisters, or cousins).

Nearly all the gang members are school age, but they don't attend school. Most have been arrested a number of times for truancy, violent crimes, or drug dealing, while others have been suspended for carrying weapons in school and for recurrent misbehavior. G-Love and Sweet Pea say that when they started elementary school, they didn't get along with anyone there, hated the teachers, didn't want to listen to orders, and ran away to the street. By the eleventh grade, both had dropped out and preferred the company of youngsters on the street to those in the playground. "Kids on the street were like me," notes G-Love.

Daily life for these street kids is simple, often boring, and relatively free from the stresses that affect mainstream adolescents. When school kids are running around the neighborhood on early morning paper

Daily life for street kids is simple, often boring, and relatively free from the stresses that affect mainstream adolescents.

routes, waiting for the school bus, attending algebra and chemistry class, doing homework, practicing team sports, heading off to part-time jobs, and worrying about scores on college entrance exams and picking a college, Fairview Hawks are asleep, numbing themselves with drugs, or just hanging out.

The gang has four "chill spots," or houses where the kids are permitted to hang out. G-Love's mother's house is the biggest, most popular spot. Up the street, kids chill at Tonya's and rely on her for support. "Tonya—she's a mom, she's got kids and everything—is like the mom of the family," says Caramel. "She's close to Dan, TJ, Chucky D, and Kirk. She is the one that all the boys write and call from prison. If any of us go to jail, we always call Tonya's house." Caramel laughs.

The day begins sometime between one and three in the afternoon. Sleeping all morning and most of the afternoon is a regular practice because these teen-agers don't go to sleep until three or four A.M. They don't have to awaken early because they've all quit school and only a few have jobs. And those who do get jobs usually quit within weeks. Between four and six in the afternoon, the everyday group starts to congregate around G-Love's front porch; a few go inside to watch TV or play video games.

Before long, someone walks a few blocks to a gas station convenience store on 61st and buys some forty-ounce bottles of malt liquor or beer. Then someone rolls a joint (marijuana cigarette) or prepares a blunt (a hollowed-out, blunt-tipped cigar filled with marijuana). Or someone lights up what they call a "dank stick"—a cigarette dipped in formaldehyde that's been cut, or thinned, with nail polish remover or even wood alcohol or brake fluid. Smokers of dank become high instantly: legs weaken and bodies sag lifelessly. Sweet Pea says, "It makes you not think about none of your problems at all."

The kids chat and gossip and listen to music. On some weekend evenings, they may move into someone's house and dance to rap music. Boys may toss a football up and down Fairview in front of G-Love's house or play basketball at a public park a few blocks away. Less often, gang members go swimming in a public pool, attend a movie, or go wading in a large public fountain that's a few miles away. Favorite pastimes are dominoes and craps—they love to gamble.

G-Love says they usually don't go looking for trouble unless they're really "messed up" (drunk and/or high on drugs) and have a car. Nevertheless, violence is

Street kids are unlikely to get help unless they are sentenced to prison. And it isn't the worst thing that can happen to them.

a fact of life and includes drive-by and walk-by shootings. Although they weren't the intended victims, Caramel and G-Love were injured during a walk-by shooting one August evening. They were sitting in G-Love's car, just around the block from her mother's house, when a North gunman fired an SKS assault rifle at them for "two to three minutes," according to Caramel. A number of Fairview boys at the scene were unhurt, but G-Love was hit in the face and back by fragments of shattered glass or metal, and Caramel was hit in the foot by a bullet and received other wounds. G-Love managed to drive the car away from the scene. Shootings like this one are an "ongoing process," explains Caramel. "They'd shoot at our friends, so we'd get mad and retaliate back on them, then they'd get mad and retaliate back on us."

I watched one afternoon as gang members prepared for battle, having spotted several members of North a few blocks west of Fairview and 60th. Hostile words and threats were exchanged, and boys emerged from houses along Fairview and dashed toward a high spot on the hill next to G-Love's, a vantage point from which to fire down on enemy gang members driving below. Weapons appeared from hiding spots: shotguns, high-powered rifles, an assault weapon, a semiautomatic weapon, and powerful handguns. "It's some funny shit, man," declared a young warrior. "I'm gonna jump right out in the middle of the street. It's the Fourth of July!" Another exclaimed, "I'm ready to rock 'n' roll. I'm ready to ride." They darted back and forth along the ridge, seemingly oblivious of their own exposure to danger.

According to several Fairview Hawks, quite a few of the gang members have been wounded or killed by firearms during the year. A twenty-five-year-old man was shot in the chest four to six times by unknown killers. A twenty-three-year-old was murdered by

North gang members, two years to the day after his brother was killed by Bloods. A sixteen-year-old was shot accidentally, and his fifteen-year-old brother was shot by a rival; both survived. A seventeen-year-old boy was shot in the head by a rival and now sits permanently in a wheelchair. A fourteen-year-old boy was accidentally shot in the head by his best friend as they handled a .45 caliber handgun. A thirteen-year-old girl survived being shot in the chest with a .38 handgun by North. A sixteen-year-old was shot in the arm with a 12 gauge shotgun at close range in a drive-by shooting on Fairview. Two seventeen-year-old boys survived being shot at by rivals. Gang-related tragedy hits the families of these kids, too.

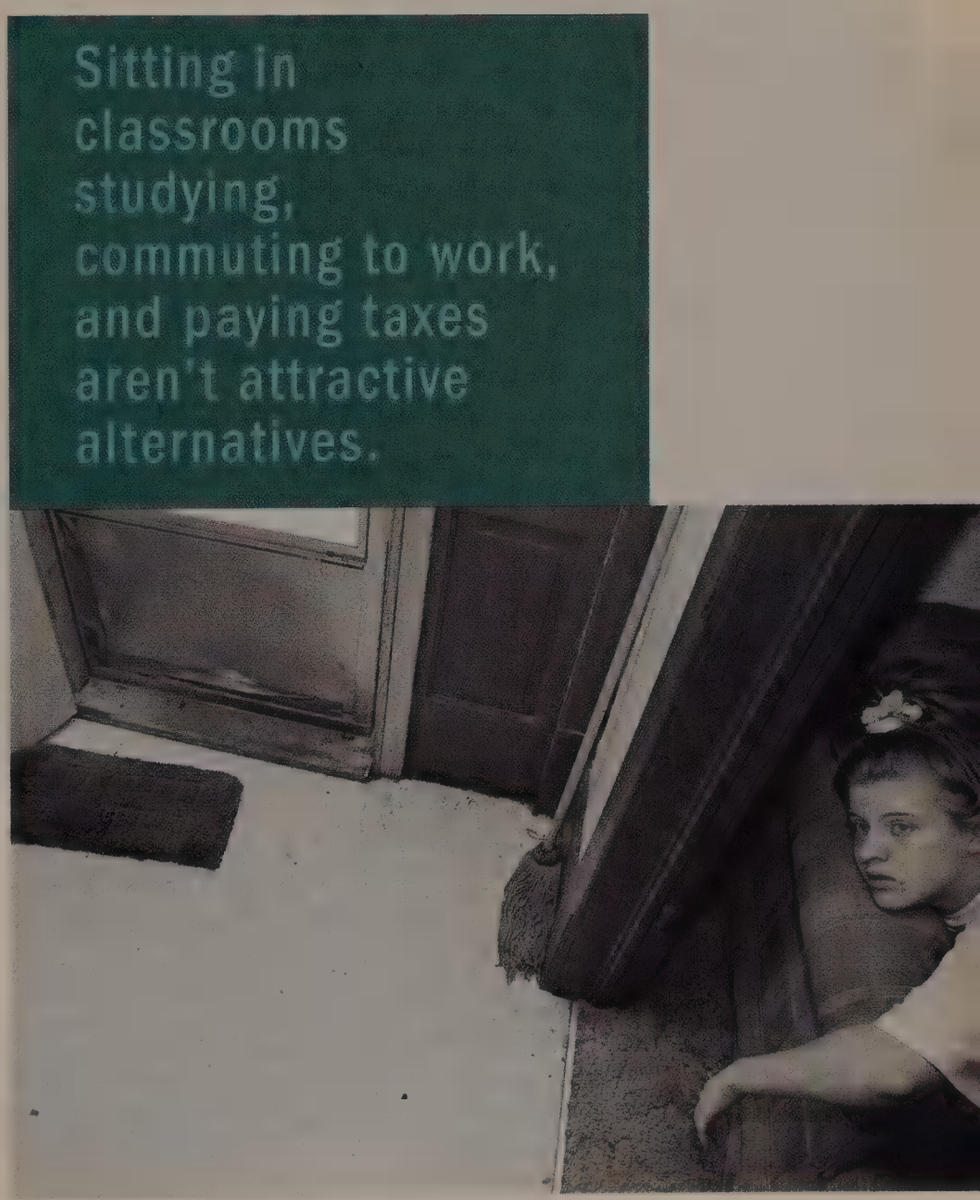
"Violence doesn't scare me. I'm used to it. It's normal," says Poodle in a matter-of-fact voice. "I seen shootings and drive-bys." Fist fights don't frighten her either. Indeed, she was arrested for assault after punching her mother in the face during a court hearing. ("We used to get into fist fights at home, too.") But Caramel says, "My biggest fear is watching all my friends die. I don't want to fear dying. I don't want to die violently. It'll all get better someday. I wish it would all stop."

Life in the Fairview district can be dangerous, but most of these teen-agers were first exposed to violence at home. In years of research in prisons and jails and on street corners in Seattle and other cities, I have interviewed and hung out with hundreds of gang members and adult street criminals, ranging in age from the late preteens to nearly seventy. The families they were born into usually offered only fragile and undependable social ties, with children bound only weakly to their parents or other adults who helped raise them (stepparents, aunts, uncles, cousins, grandparents).

Most commonly, the parents are alcoholics, and many use other drugs as well, such as marijuana, heroin, and cocaine. Many fathers are criminals, often drug dealers. Mothers, and sometimes grandmothers, engage in criminal activities with their husbands, brothers, sons, and nephews. Even women who do not participate in crime are active consumers of the money and goods obtained illegally. Parents fight with each other and beat their sons and daughters. In many cases, men sexually molest their sons, daughters, or stepchildren. Mothers of these children are passive bystanders who pretend not to know—fearful, they say, that they might be beaten themselves or have their supply of drugs cut off.

As the children mature, the neglect and the emotional and physical abuse heaped on them persist. Eventually they pull away, abandon their homes, and embrace street life with a calamitous zest. Enjoying the freedom of living by their own rules, they set off on a life of drug and alcohol addiction, personal irresponsibility, an inability to form meaningful social attachments, an incapacity to sort important aspects of their lives from unimportant ones, impulsive behavior, aggression to relieve stress, and no sense of lifelong priorities. Many of these damaged adolescents feel as if the course of their lives is outside their control. When confronted with the facts about their drug and alcohol use, dim future, violent behavior, and lack of education, they often respond, "It's just who I am."

Fairview Hawks, like young gang members I've studied in many other cities, usually are the products of particularly destructive family experiences. Institutionalization is also common in their backgrounds. Caramel recounts a series of seven placements in residential treatment programs, hospitals, and juvenile detention facilities, from when she was age ten to seventeen, including nearly a year in a state hospital at age



thirteen. She says they told her she had "an anger problem and a chemical imbalance." During her last commitment to a treatment facility, Caramel met G-Love, who also was a patient.

G-Love says she smoked her first joint when she was eight, and by age twelve she drank and smoked "bud" (marijuana) every day, gambled, enjoyed an occasional street fight, and stole cars. After a car theft when she was twelve years old, G-Love was remanded by a juvenile court judge to a thirty-day psychiatric evaluation. But she rebelled, and a month turned into four years in custody. "I hated the matrons," she says with a scowl, and "I fought them, jumped them, beat them whenever I could, and I ran away. But they kept bringing me back." G-Love adjusted slowly and learned to live with counseling, planned recreation, good food, and a clean bed.

These kids are unlikely to get help unless they are convicted of a felony and sentenced to prison. And ironically, prison isn't the worst thing that can happen to them. In fact, it is a way of insuring that they will

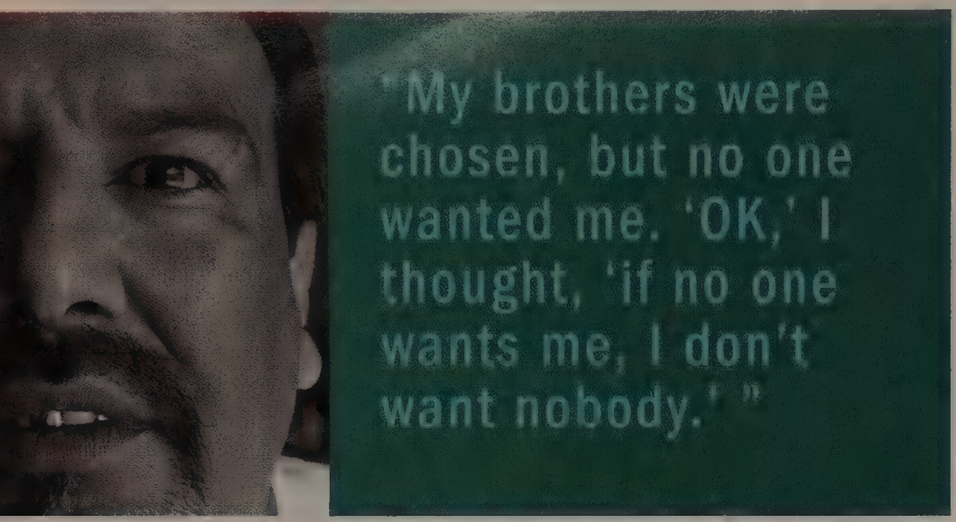
Weapons appear from hiding spots: shotguns, high-powered rifles, an assault weapon, a semiautomatic weapon, and handguns.

stay alive, get treatment for addictions to alcohol and other drugs, receive a moderate level of education, and obtain medical and psychological or psychiatric care. Most prisons, despite exaggerated stereotypes, are cleaner and safer than inner-city neighborhoods. In prison, there are no drive-by shootings.

Whether so-called rehabilitation programs can be considered successful depends on who is evaluating the programs. Educated people, among them those whose incomes depend on the existence of such programs,

often claim that education and job training will stop crime and offer street criminals lawful opportunities. My years of street ethnography show a different picture: Persistent criminals, as well as gang members, are living a life style they have chosen. They don't fear the criminal justice system, and in the end, most reject attempts to force them into a way of life they neither want nor understand. Sitting in classrooms studying, commuting to and from work, spending forty or more hours a week behind a desk, and paying taxes aren't attractive alternatives to the street criminals and gang members I've known.

Fairview Hawks and kids like them usually are raised by parents for whom school has no meaning. School is just a place to hang out with fellow gang members. And a close look at household life shows that the parents of gang members often discourage children's school attendance, because the school day and homework take time away from selling drugs or stolen property, thus reducing household income and



the amount of cash that mom or dad can spend on drugs and alcohol. And even if the children are educated, who will hire them?

Some gang members and adult street criminals do find a way to get off the street and into a lawful life style. Grass-roots organizations that reach people on street corners and in gang neighborhoods are a more effective intervention tool than expensive, bureaucracy-laden government programs. The Fairview Hawks are more likely to get help from people who aren't afraid of going into the inner city, having once lived on the street themselves.

Flaco, in his mid-forties, used to work for a neighborhood organization and is now setting up his own project. He is the first bilingual Latino to become a certified drug and alcohol counselor in the state. He even received a certificate of recognition from the Points of Light Foundation inspired by President Bush. But for many years, his life consisted of drugs, crime, gangs, and prison.

Born in Nogales, Mexico, and raised in Tucson, Arizona, Flaco lived until the age of nine with his mother and stepfather. Then his mother was hospitalized and his stepfather was unable to care adequately for Flaco and his six brothers. His mother's relatives offered to care for the children, but they only wanted Flaco's brothers. He was left on his own. "I remember the conversation where my brothers were chosen, but no one wanted me. 'OK,' I thought, 'if no one wants me, I don't want nobody.' "

Flaco soon began sniffing glue and gas fumes; by age ten, he was regularly smoking weed; by age twelve or thirteen, he was a member of a gang in south Tucson. He shot (injected) heroin for the first time at age fifteen. For the next two decades, his life was dominated by heroin. "If God made anything better than heroin," says Flaco, "he kept it for himself."

At age twenty, Flaco was imprisoned in the maximum security unit at the Arizona State Prison for selling heroin, among other charges, and within a year, he became associated with one of America's most infamous prison gangs, known for its violence and drug distribution inside prison walls. For nearly fourteen years, Flaco lived by the sword and the syringe. "I felt closer to the guys in prison than to my own family. Sometimes I forgot I had a family. I never got a visit, and I lost all contact with the world."

On September 1, 1985, Flaco was released. At age thirty-three, he didn't know how to live on the outside. "My [criminal] behavior and attitude kept me alive all along, and now they expected me to get rid of all that. I didn't know if I could make it." Flaco decided to stay drug free for twelve months, just to see what the world looked like. He has managed to stay drug free ever since.

Unfortunately, kids have only a slight chance of getting off the street when the majority of the people they know—including their own brothers, sisters, cousins, mothers, and fathers—are active criminals, gang members, and drug addicts. Supportive, intimate ties are optional on the street, where relationships exist in the moment and people are responsible only for themselves. As a field researcher studying adult street criminals and young gang members, I found that reciprocity and frequent contact were vital to sustain open relationships. But I learned to limit my natural urge to get personally involved. "I am a street ethnographer," I told myself, "an observer, not a cop, social worker, or surrogate father."

But watching adults destroy their lives with drugs and alcohol and criminal behavior was easier to endure than watching adolescents do the same things. Adults, I told myself, have control over their own lives. If a thirty-five-year-old street criminal chooses to shoot heroin, that is entirely his decision. But I watched teen-agers pollute themselves with alcohol, marijuana, and dank, and no adults seemed to care about this drug abuse. Every day I spent with the Fairview Hawks brought me disturbing dreams. I knew that many of these youngsters had committed serious crimes, but many of them had not, yet all were trying to survive as best they could, alone on the street, without community members rescuing them.

One thing I learned from studying Fairview Hawks is this: These youngsters would probably not be alcoholics, drug addicts, gang members, and convicted felons if their parents or other adults truly cared about them. And this is the most painful thing I have learned on the streets. □

Books to Read

Beggars and Thieves: Lives of Urban Street Criminals, *by Mark. S. Fleisher (University of Wisconsin Press, 1995)*

The American Street Gang: Its Nature, Prevalence, and Control, *by Malcolm W. Klein (Oxford University Press, 1995)*

Bosnia: After the

Story by Colin Finlay and Christina M. Gonzalez
Photographs by Colin Finlay: Saba Press Photos,
and by the children of Sarajevo

"Peace is back. People want it," says Hamid, a teenager who lived through the siege of Sarajevo from 1992 through 1995. The city, ringed by mountains, had come under attack by nationalist Bosnian Serbs after Bosnia and Herzegovina declared independence from Yugoslavia. The victims were Bosnian Muslims, Croats, Serbs loyal to the Bosnian government, and a small community of Sephardic Jews. At one point, echoed with exploding mortar rounds and artillery and sniper fire, Hamid spent days and nights crushed with scores of other people in a tiny underground bunker. Even now, gunfire may be heard in the hills, and memory is such that someone doesn't jump from a noise unrelated inside or on the outskirts of the city.

Hamid was one of fifteen children—girls and boys—in Alma Ismić's Sarajevo classroom when we arrived in mid-October 1996. We asked them to play the role of journalists, to show through their eyes the experience of the siege and what their lives are like today. As they documented what they saw and felt, we followed them with still and video cameras. They took us on a tour of the main library—or what's left of it—once a world-

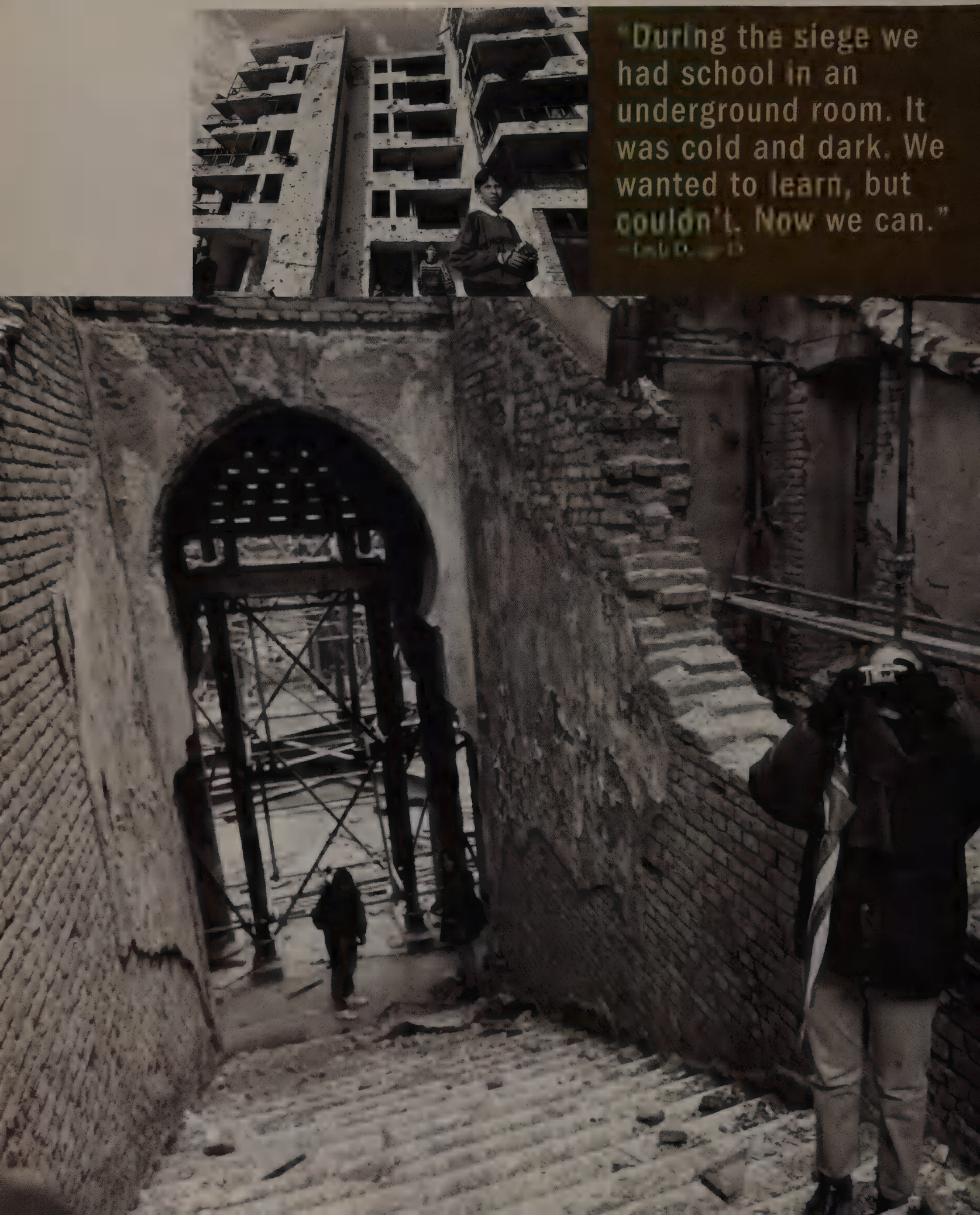
Photographs by Colin Finlay

War Without End

renowned invention where architecture, as well as cinema, had been a tribute to cultural diversity. We negotiated the roadblocks and made our way through rainwater to see the children's destroyed homes, parks, and schools. We viewed the scarred city center, where shell-pierced buildings were patched with a mixture of ash, blood, and powder to shelter the living.

Following the Dayton agreement reached in December 1995, Bosnia and Herzegovina remains divided into two "entities"—the Federation of Bosnia and Herzegovina and the Serbian Republic—watched over by NATO troops. The joint government barely functions, the economy is weak, more than two million refugees are still unable to return home, nationalist parties remain in power, and individuals indicted by the International War Crimes Tribunal remain free. Yet, as many Bosnians say, life is stronger than politics. The Sarajevo airport reopened recently, schools and orphanages are being built, many young people are in reconciliation programs, and the emergence of multiethnic citizens' political parties encourages the vision of a more tolerant future.

There wasn't a child we worked with who did not take a picture of a grave, for all had lost someone to the war. But many of their photographs expressed hope and the beginnings of a return to a normal life.



"During the siege we had school in an underground room. It was cold and dark. We wanted to learn, but couldn't. Now we can."

Photographs by Colin Finlay

"This library was a beautiful building. I see that it burned, but now it is being restored. In the future this will be a wonderful library."

—Ana S., age 14

Books to Read

Letters from Sarajevo: Voices of a Besieged City, *by Anna Cataldi (Element Books Limited, London, 1994)*

Zlata's Diary: A Child's Life in Sarajevo, *by Zlata Filipovic (Viking Press, 1994)*

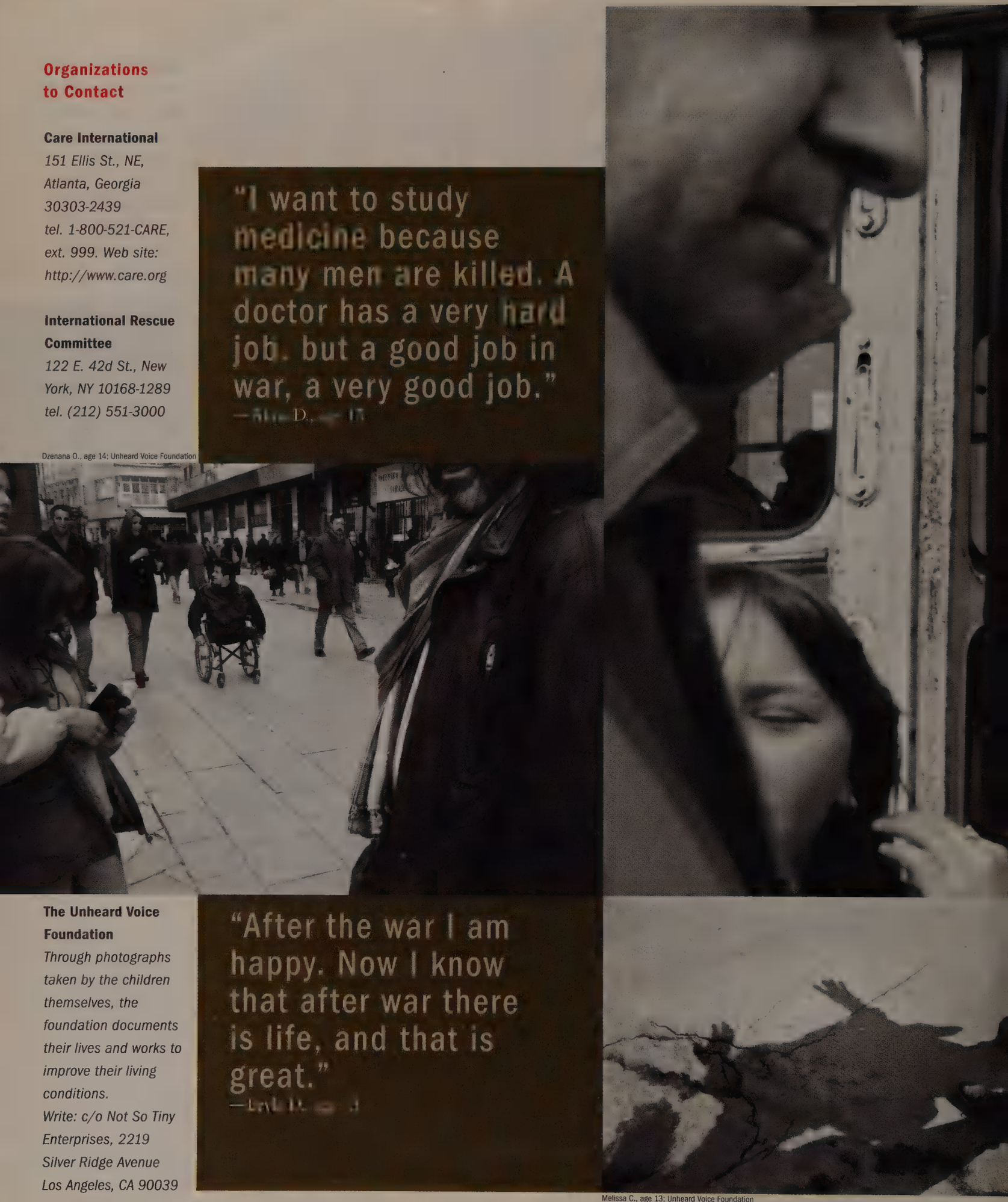
Bosnia and Hercegovina: A Tradition Betrayed, *by Robert Donia and John V. A. Fine (Columbia University Press, 1994)*

Organizations to Contact

Care International
151 Ellis St., NE, Atlanta, Georgia 30303-2439 tel. 1-800-521-CARE, ext. 999. Web site: http://www.care.org

International Rescue Committee
122 E. 42d St., New York, NY 10168-1289 tel. (212) 551-3000

The Unheard Voice Foundation
Through photographs taken by the children themselves, the foundation documents their lives and works to improve their living conditions. Write: c/o Not So Tiny Enterprises, 2219 Silver Ridge Avenue Los Angeles, CA 90039


"I want to study medicine because many men are killed. A doctor has a very hard job. but a good job in war, a very good job."
"After the war I am happy. Now I know that after war there is life, and that is great."

Dzenana O., age 14; Unheard Voice Foundation

Melissa C., age 13; Unheard Voice Foundation

Alma S., age 14; Unheard Voice Foundation

"People should remember so they don't repeat the war, this war."

-Alma S., age 14

(Continued from page 18)

book, *The Aquarium,* exposes the social or technological solution to a number of practical problems that would probably not occur to a casual reader today. How, for example, could an urban enthusiast get seawater for his home aquarium? Gosse advises:

> *In London, sea-water may be easily obtained by a trifling fee to the master or steward of any of the steamers that ply beyond the mouth of the Thames, charging him to dip in the clear open sea, beyond the reach of rivers. I have been in the habit of having a twenty gallon cask filled for me, for which I give a couple of shillings.*

In the first edition (1863) of Louis Figuier's The Earth Before the Deluge, *a lithograph depicts Devonian sea creatures cast up on the beach.*

And how can specimens be safely transported to town with adequate speed? By fast train, of course. Gosse writes:

> *The more brief the period during which the specimens are* in transitu *the better. Hence they should be always forwarded per mail train, and either be received at the terminus by the owner, or else be directed "To be forwarded immediately by special messenger." The additional expense of this precaution is very small, and it may preserve half the collection from death through long confinement.*

Any social movement must illuminate its own time, so we should scarcely be surprised by this retrospective enlightenment from the aquarium craze of the 1850s. But what can we say about the even more interesting (and practical) matter of definite and permanent influences extending forward to our own day? Can a movement that treaded so transiently (however intensely) on the pathway of history—and then was gone like the wind—leave any lasting imprint upon posterity? In one trivial sense, of course, we can only answer this question affirmatively, for aquariums retain strong popularity in all scales of life—from hokey commercial theme parks to lofty public museums, from research laboratories throughout the world to home displays (with an interesting tie to social circumstances, at least in the United States, where cultivation of tropical fishes remains as resolutely working class as bowling, while the skiing and sailing crowd favors bird-watching or African safaris for their natural history fix).

I take a far greater interest in "invisible" matters usually passing beneath overt notice because solutions seem so obvious that we do not even acknowledge the existence of a question. Some ways of knowing or seeing seem so blessedly evident, so unambiguously ineluctable, that we assume their universal and automatic practice from time immemorial. Og the caveperson, Artie the australopithecine, even Priscilla the Paleocene primate ancestor must have used the same devices. But when we can show that such a strategy of thought or sight arose from a recent and specific episode in our actual history, then we obtain our best illustrations for the important principle that all knowledge must arise within social contexts—even the most obvious factual matter based on direct and simple observation (for one must first ask the right question to secure the proper observation, and all questions emerge from contexts).

Little examples of big principles strike me as most intriguing of all, for I declare my allegiance with several common mottoes proclaiming that God, the devil, or any matter of great pith and moment lies in the details. I believe that we can identify one of these admittedly small but obviously permanent and universal modes of seeing as, instead, a direct legacy of the mid-nineteenth-century aquarium craze, and therefore not much more than 100 years old as a Western way of knowing.

How shall we draw marine organisms and more general scenes of underwater communities? The answer to such an inquiry seems so evident that we may wonder why anyone would bother to pose the question at all. We always draw such scenes in a single and "natural" orientation today: in the eye-to-eye, or edge-on, view, where a human observer sees marine life as if he were underwater with the creatures depicted and therefore watching them at their own level. Isn't this orientation clearly best? After all, we wish to show these creatures as they live, pursuing their ordinary behaviors and interactions. How else could we possibly draw them except from within their own marine environment?

Such a preference may seem both natural and unassailable—and therefore constant and permanent in human practice—but the history of illustration reveals a different and much more interesting story. Until the mid-nineteenth century, marine organisms were almost always drawn either on top of the water (for swimming forms, mostly fishes) or cast up on shore and desiccating on land (for bottom dwellers, mostly invertebrates). These views from above, and from a terrestrial

vantage point, had become conventional in the history of art. For example, to invoke the gold standard of pre-nineteenth-century illustrations for the history of life, consider the engravings (see pages 16 and 18) for the origin of fishes and marine mollusks in the *Physica sacra* of the Swiss savant J. J. Scheuchzer, published in the 1730s.

This amazing work—the equivalent, for its time, of an elaborate television series with the usual tie-ins from books to coffee mugs—includes 750 gorgeously elaborate, full-page engravings depicting every biblical scene with any plausible implication for natural history. The Creation stories of Genesis (chapters 1 and 2) provide obvious fodder for an extensive series of illustrations. All marine organisms are drawn on top of or out of the water—that is, from the perspective of a human observer standing on shore. The plate for the creation of mollusks shows clams and snails draped over a rocky arch or lying on the beach in the foreground, while no organisms at all appear in the background ocean. The plate for the creation of marine vertebrates shows a garland of fishes along the top and upper side borders (that is, *above* the ocean), while a few swimming fishes partly protrude above the water's surface, and flying fishes grace the air spaces above.

Illustrating marine animals of the Carboniferous period, a postaquarium perspective is evident in Figuier's fourth edition (1865).

I can imagine only one reason for a strong convention of such strikingly suboptimal illustrations. Artists must then have avoided—or not even been able to conceptualize—the eye-to-eye, within-their-own-environment viewpoint so favored today. Illustrators must have eschewed this edge-on orientation because most people had never seen marine organisms in such a perspective before the invention of the aquarium, and the craze for maintaining such a display as a rustic adornment in the home converted the formerly inconceivable (because unseen) into a commonplace. Water is usually muddy and largely opaque when in motion. No technology of face masks, diving bells, snorkels, or oxygen tanks existed—and humans do have to come up for air after very short periods of potential observation. The vast majority of Western people (including most professional sailors) couldn't swim and wouldn't have thought of immersing themselves voluntarily in marine waters. So where, before the invention of aquariums, would most people ever have seen (or even been able to imagine) marine organisms in their own environments? The conventional, if uninformative, view from the shore (and down upon the waters) surely represented the "natural" way of human knowing before aquariums opened a new and truly improved perspective.

Martin Rudwick, an excellent paleontologist in his early career and now the world's most distinguished historian of geology, first made me aware of this interesting change in the history of illustration and the probable inspiration provided by the invention of aquariums. In his remarkable book on the history of drawings for prehistoric life, *Scenes from Deep Time* (University of Chicago Press, 1992), Rudwick noted that virtually all early illustrations depict marine organisms exclusively as assemblages desiccating on shore—quite a limit for learning about past communities and environments, especially when you realize that most of life's history featured marine organisms only. Rudwick writes:

> *Most scenes from deep time . . . portrayed ordinary marine organisms as having been washed up on a shore, in the foreground of a landscape seen unproblematically from a human viewpoint. In this respect, they simply continued the established pictorial convention. . . . In effect, the aquatic world from which most fossils were derived was depicted only from the outside, from the subaerial world to which a time-traveling human observer could more plausibly have had access. . . . This suggests how difficult it may have been for the public . . . and perhaps for most of the geologists too, to imagine a viewpoint that was not only prehuman but also subaqueous—at least until mid-century, when the famous aquarium craze made the underwater world generally accessible for the first time.*

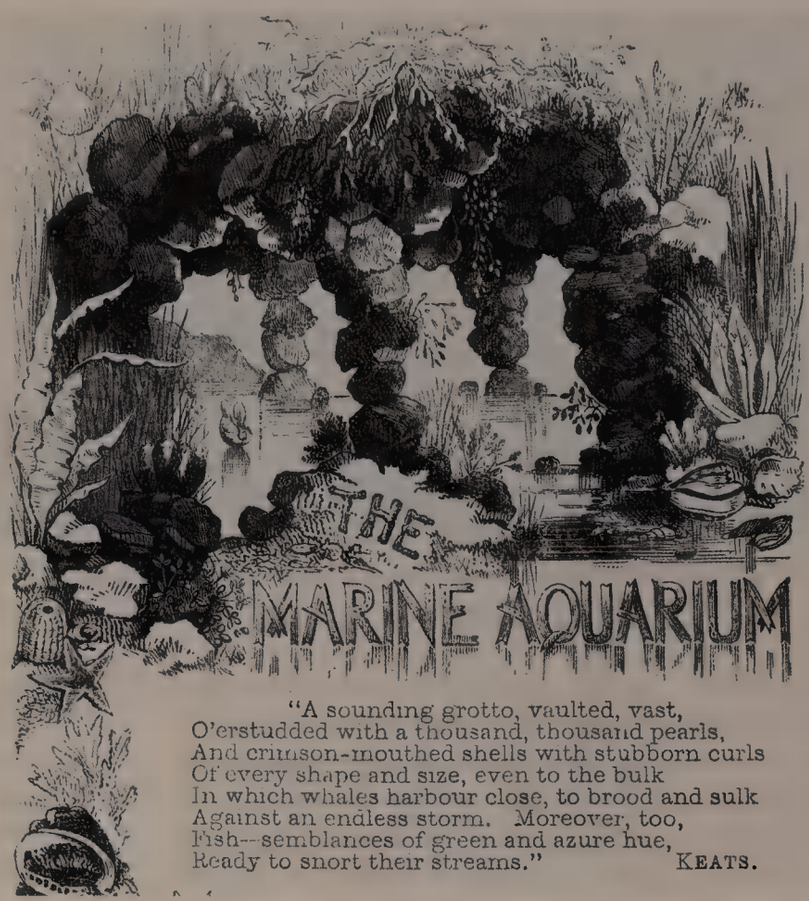
I don't mean to exaggerate the exclusivity of this theme. The eye-to-eye view is not that hard to imagine, even if you have never seen marine life in this orientation—and fishbowls did provide some simplified hints. Thus, one occasionally encounters the "modern" view in old illustrations. (The earliest I have seen comes from a sixteenth-century German book on military tactics showing a soldier—or should I say a marine—stealthily walking along a lake bottom to gain access to an enemy ship and drill some holes for a sinking. The figure shows a few fishes swimming in the water but in a very stiff and clearly subsidiary role.)

But Rudwick is surely correct in noting the rarity of such drawings, and he

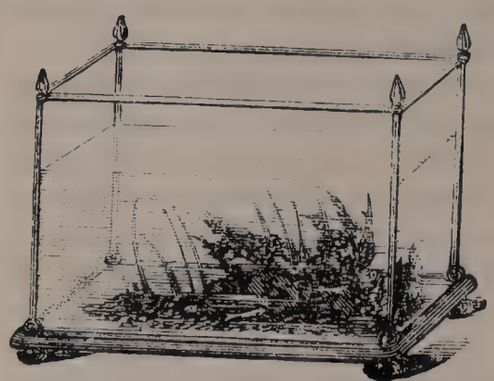
also notes that occasional exceptions usually record irregular or humorous purposes, while the same artists then used the conventional onshore view in textbooks and other standard sources. For example, in 1830, and long before the aquarium craze, Sir Henry De la Beche, the first director of the Geological Survey of Great Britain and a skilled illustrator as well, made a famous drawing of Mesozoic marine life in Dorset from the modern eye-to-eye perspective. He printed this figure to sell in a campaign designed to raise money for Mary Anning, the celebrated fossil collector, who had become impoverished. But when De la Beche, only two years later, published figures of the same ichthyosaurs and plesiosaurs in a popular textbook, he drew these animals either on shore or on top of the water.

I have informally monitored this theme in my historical readings during the past five years, and I can affirm Rudwick's claim that the "natural" edge-on view did not become at all obvious until the aquarium provided access for ordinary human observation. Moreover, since all inventions experience some lag time before general acceptance, I have also noted that eye-to-eye marine views did not predominate during the aquarium craze of the 1850s, but only achieved preferred status during the next two decades.

To cite two examples of reluctance to abandon old conventions, Hibberd (in 1858) does show several figures of aquariums from the side. (These rustic adornments establish the primary subject of his book, after all, so he could hardly have done otherwise!) But nearly all Hibberd's drawings, while showing a side view through glass, assume the perspective of an observer looking down from above the aquarium, not directly from the side (and level with the fishes). Moreover, Hibberd's decorative drawings for the first page of each chapter continue to promote the desiccating, shore-bound view, as illustrated by the grotto of invertebrates gracing chapter 1, "The Marine Aquarium."


THE
MARINE AQUARIUM
"A sounding grotto, vaulted, vast,
O'erstudded with a thousand, thousand pearls,
And crimson-mouthed shells with stubborn curls
Of every shape and size, even to the bulk
In which whales harbour close, to brood and sulk
Against an endless storm. Moreover, too,
Fish--semblances of green and azure hue,
Ready to snort their streams." KEATS.

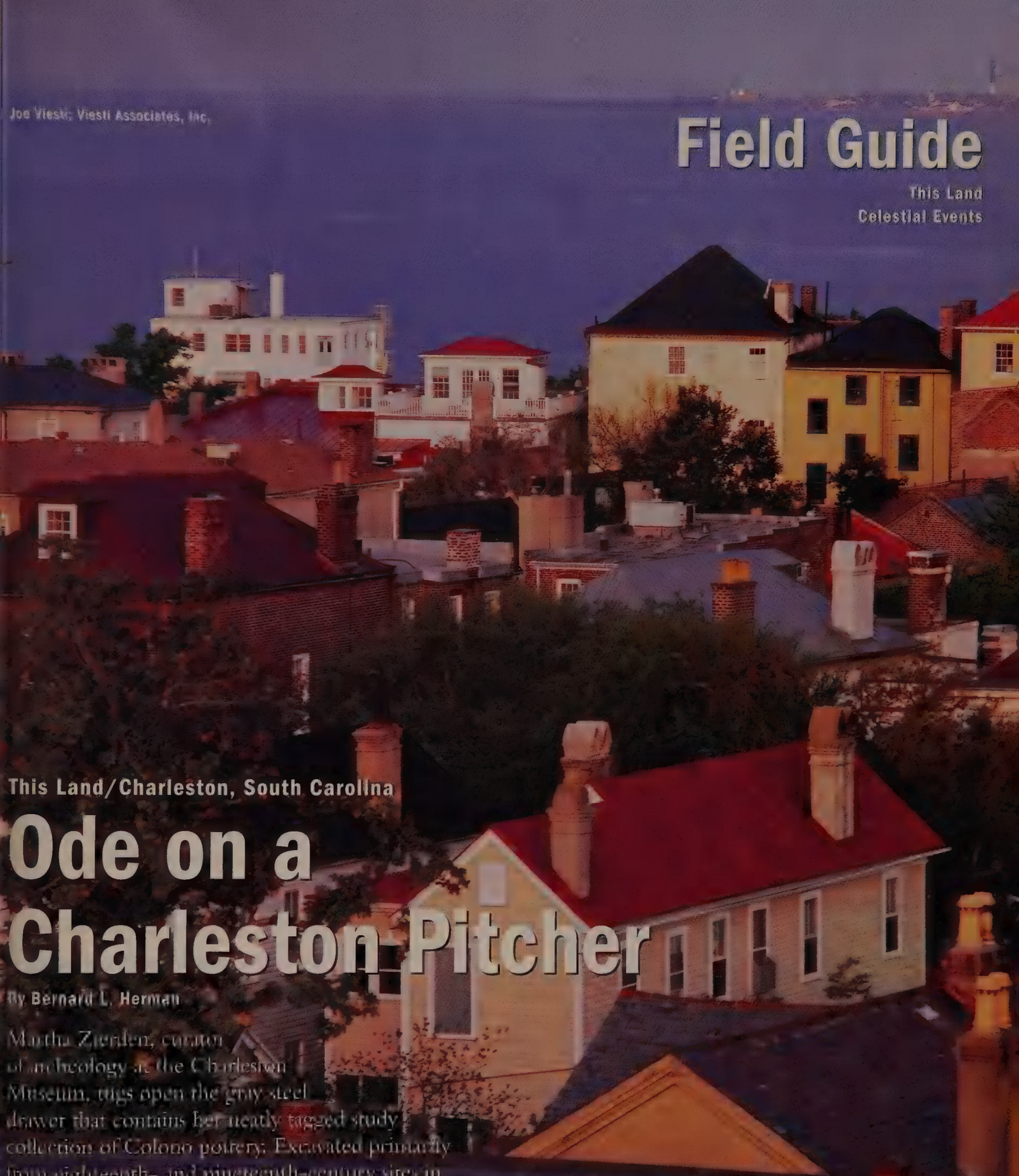
A chapter heading in Rustic Adornments *reflects the old style of marine illustration, as does the top-down view of the aquarium itself.*



In a striking example (cited by Rudwick as well), the immensely popular French naturalist Louis Figuier—the Carl Sagan or David Attenborough of his day—published the first major book of chronologically ordered scenes for each period of life's history, *La terre avant le déluge* (*The Earth Before the Deluge*). His lithographer, Edouard Riou, worked for Jules Verne (among others) and was the most celebrated illustrator of popular science in his time. In the first edition of 1863, Riou drew all marine creatures in positions of death and desiccation on shore. He retained these figures in later printings, but added, in the fourth edition of 1865, a much more informative drawing of Carboniferous fishes and marine invertebrates in the newly familiar edge-on aquarium view.

Very little comes easily to our poor benighted species (the first, after all, to experiment with the novel evolutionary inventions of self-conscious philosophy and art). Even the most obvious, accurate, and natural styles of thinking or drawing must be regulated by history and won by struggle. Solutions must therefore arise within a social context and record the complex interactions of mind and environment that define the possibility of human improvement. To end by parody of a familiar text, we only learned the natural way to see marine life when the invention of aquariums permitted us to see through glass clearly and to examine a brave old world face to face.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University. He is also the Frederick P. Rose Honorary Curator of Invertebrates at the American Museum of Natural History.



Joe Viesti; Viesti Associates, Inc.

Field Guide

This Land
Celestial Events

This Land/Charleston, South Carolina

Ode on a Charleston Pitcher

By Bernard L. Herman

Martha Zierden, curator of archeology at the Charleston Museum, tugs open the gray steel drawer that contains her neatly tagged study collection of Colono pottery. Excavated primarily from eighteenth- and nineteenth-century sites in Charleston and the surrounding South Carolina Low Country, the shards come from hand-molded vessels that were distinct from the English earthenware, European and Asian porcelains, and elaborate glassware that were in popular use at the time. (English "refined-body" earthenware, such as Staffordshire creamware and pearlware, was so cheap and available in Charleston at the close of the

eighteenth century that discarded fragments are common in abandoned privies—"wet" sites that preserve everything from wood construction debris to gastrointestinal parasites.)

Using criteria developed by her museum colleague Ron Anthony, Zierden distinguishes three categories of these little-understood ceramics, which make up about 5 percent of the ceramics in Charleston archeological sites dating from the colonial period into the early nineteenth century. Yaughan ware and Lesesne ware include a variety of bulbous pots, while River Burnished pottery most often follows the forms of European vessels—handled pitchers, teapots, and footed plates and bowls.

John Elk III

Magnolia Plantation and Garden, Charleston

Thirty years ago, scholars assigned the creation of Colono ware to Native Americans. The River Burnished ware in particular resembles what is known as Catawba ware: varied forms of smoking pipes, pitchers, and jugs produced by Native Americans in the Carolina back country, carried to Charleston, and sold or bartered to city residents of both European and African descent. More recently, archeologist Leland Ferguson, of the University of South Carolina, and others have interpreted some Colono ware as the product of a West African tradition tied to certain African American foods, herbal medicines, and religious practices. They believe the tradition was transplanted to the American colonies through slavery. Possibly, as archeologist Brian Crane proposes, it arrived indirectly, after first becoming established on Caribbean islands.

An example of River Burnished ware is a fragmented pitcher whose shards were excavated from a privy in the old part of Charleston. With its flat base and strap handle, the six-inch-high vessel drew on a popular European form, but its burnished, hand-molded body and ornamentation—there is a trace of stylized figures painted within a black oval outline—distinguish it from the mass of English-manufactured dishes, mugs, chamber pots, and other

Yaughan vessels are thick-bodied, globular pots that may have served a variety of storage and cooking functions. They range in color from burnt browns to deep, irregular grays.

Lesesne vessels tend to be slightly more delicate than Yaughan vessels, with burnished surfaces in a color range that also includes darker browns and tans, as well as the gray of Yaughan.

River Burnished wares are harder fired and thinner walled than other Colono wares. Ranging in color from mottled gray to black, they are highly buffed, to the point of looking as if they had been glazed. Occasionally they are decorated with painted designs. River Burnished resembles Catawba ware and most likely belongs to the same tradition.

Catawba pottery consists of contemporary as well as earlier wares known to have been produced by the Catawba Indians. It includes hard-fired holloware such as pitchers and jugs, which range in color from mottled gray to black and have burnished surfaces

South Carolina Institute of Archaeology and Anthropology

Yaughan

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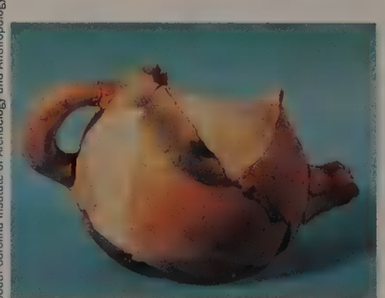
Lesesne



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River Burnished

Leigh Richmond Miner, Penn School Collection

ceramics that were found along with it. The privy stood adjacent to the kitchen quarters of an eighteenth-century house, placing it at the intersection of the worlds of masters and servants.

If the pitcher came from the kitchen, or from the slave quarters above the kitchen, it may have been used for mixing and dispensing African medicines. But perhaps it came from the town house and reflected the fascination with natural and cultural exotica that was very much a part of late-eighteenth-century European American households throughout the North Atlantic rim. Silver-inlaid or mounted coconut-shell cups, gold-mounted ostrich eggs, and cowrie shell snuff boxes and cufflinks were objects that brought "foreign" cultures into the home and symbolized the ability to contain and domesticate them. Set on a parlor mantelpiece or in a curio cabinet, the pitcher may have affirmed the homeowner's sense of cultural authority.

Urban elites who collected such objects may well have missed the point that River Burnished wares were intended by their makers for sale and represented a thoughtful and critical reading of "white" desire. The potters—Native American and/or African American—made choices based on a variety of factors, including the quality of clay, potting and firing technologies, competing design traditions, and marketability.

Historians who write about early American decorative arts generally take a top-down perspective, emphasizing great works that have strong social associations with upper-class taste and wealth. Lesser works are demeaned as imperfect reflections of this aesthetic standard. The River Burnished Colono ware challenges the wisdom, or even the utility, of such taste-based categories. For an archeologist, the presence or absence of Colono ware is best viewed as a clue to the interplay of ethnic identities and a reminder of the dynamic settings in which objects could be inscribed with multiple, often conflicting, meanings.

Bernard L. Herman is an associate professor of art history, history, and urban affairs and public policy at the University of Delaware in Newark. His books include The Stolen House *and, with Gabrielle M. Lanier,* Everyday Architecture of the Mid-Atlantic: Looking at Buildings and Landscapes.

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A slave cabin at Boone Hall Plantation, Mount Pleasant

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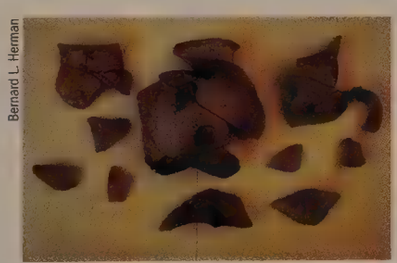
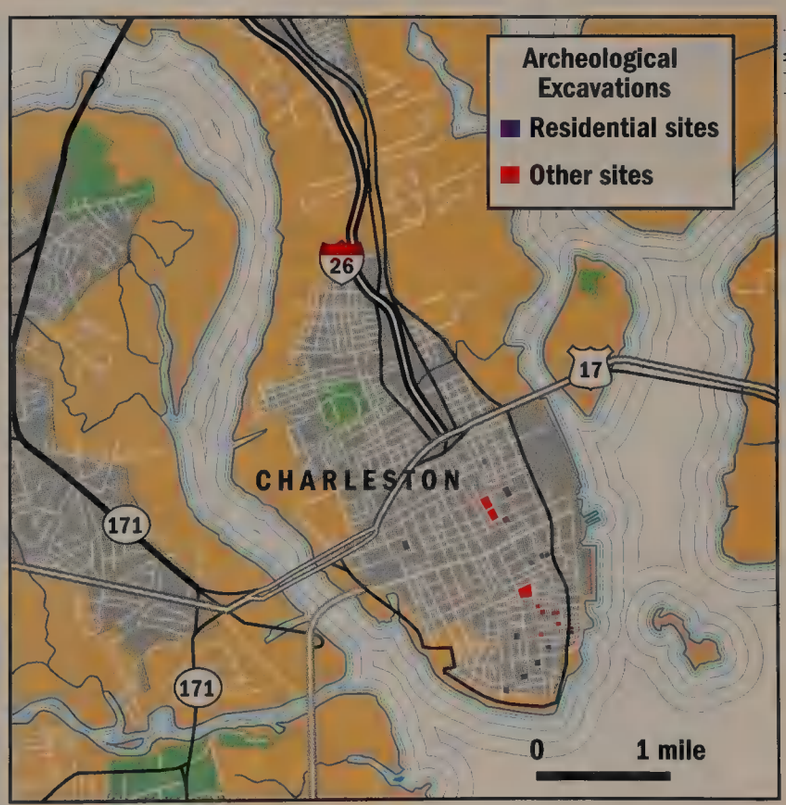
with painted designs. Catawba ware is also represented by smoking pipes, which are often decorated with geometric designs of prehistoric origin.



Bernard L. Herman

Fragments of a River Burnished pitcher excavated from a Charleston privy: Was this vessel used to dispense African medicines?

Homes of freed slaves on Saint Helena Island, about 1900–1910



Joe LeMonnier

Celestial Events

Of Scorpions and Showers

By Joe Rao

Dennis Davidson

Twinkling Antares is the brightest star in the constellation Scorpius.

In July, the constellation Scorpius, the Scorpion, is visible to early evening stargazers across most of North America. Those in the far northeastern states and Canada may not see the lowest part of the Scorpion's tail, but the constellation's most brilliant and interesting star, Antares, is well above the horizon.

At first glance, you might mistake this reddish star for the ruddy planet Mars, but notice that the star twinkles—something bright planets generally do not do. The ancient Greeks also noticed the resemblance between these two celestial bodies and named the star Antares, "rival of Ares" (Ares is the Greek equivalent of Mars). A star of exceptional dimensions, Antares' diameter is nearly 700 times that of the Sun and more than 75,000 times that of Earth; in other words, if the Earth were a baseball, a proportional Antares would be a ball more than three and a half miles in diameter. Among the bright stars, Antares is probably exceeded in size only by Betelgeuse.

The first three weeks of August bring one of the best annual meteor displays—the Perseid meteor showers. The Perseids are the debris left behind by comet Swift-Tuttle, which passed through the inner part of out solar system less than five years ago. (Most of the meteors seem to emanate from an area in the constellation Perseus, hence the name.) The Perseids will reach a peak during the early morning hours of August 12. Only then, as Perseus climbs high into the northeast sky, will the meteor numbers reach the fifty or more per hour rate that makes the shower so spectacular. After the bright first-quarter Moon sets late on the evening of the 11th, the night will be dark enough to enjoy the sight of these celestial streakers.

Joe Rao is a lecturer at the American Museum-Hayden Planetarium.

The Sky in July and August

Mercury moves steadily east of the Sun during July, reaching elongation—its farthest distance from the Sun—by August 3. Mercury moves to inferior conjunction—positioned between the Earth and the Sun—on August 31.

Venus, prominent in the evening twilight in July, stands about 15° above the western horizon after sunset and sets about one and a half hours later. Venus, Mercury, and the star Regulus lie within 5° of one another in the evenings from July 23 through 26. In August, Venus is low in the west just after sunset. The crescent Moon passes below and to the right of Venus on the evening of the 5th; above and to the left on the 6th.

Mars, low in the southwest at dusk, sets in the late evening during July. It is less than 2° south of an almost first-quarter Moon on the evening of the 11th. By month's end, Mars is a few degrees to the right of the star Spica. In August, a waxing crescent Moon is in the vicinity of Mars and Spica on the evenings of the 8th and 9th.

Jupiter, in Capricornus, rises in the southeast about one and a half hours after sunset. The planet dominates the late-night sky, far outshining even the brightest stars by nearly three magnitudes (after Venus sets). On August 9, Jupiter is opposite the Sun in our sky. On that date, this silvery white beacon is at its closest and brightest: 350 million miles from Earth and a glorious magnitude –2.8.

Saturn, in Pisces during July, rises in the east near midnight and is high in the southeastern sky by dawn. Saturn's rings are 11.7° from horizontal on the morning of the 25th, their broadest display since 1993. In August, Saturn rises in midevening and is near the meridian at dawn. It appears stationary against the stars of Pisces, until it begins its retrograde (westward) motion on the 2d.

The Moon in July is new on the 4th at 2:40 P.M. First quarter is on the 12th at 5:44 P.M., full Moon is on the 19th at 11:20 P.M., and last quarter is on the 26th at 2:28 P.M. In August, the Moon is new on the 3d at 4:14 A.M. First quarter is on the 11th at 8:42 A.M., full Moon is on the 18th at 6:55 A.M., and last quarter is on the 24th at 10:23 P.M. All times are EDT.

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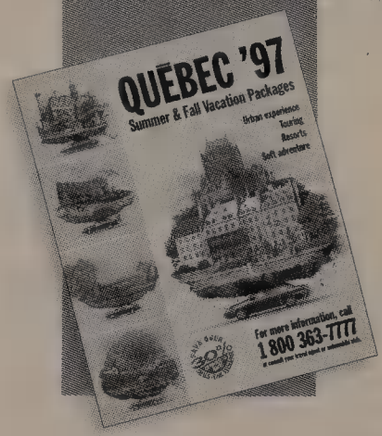

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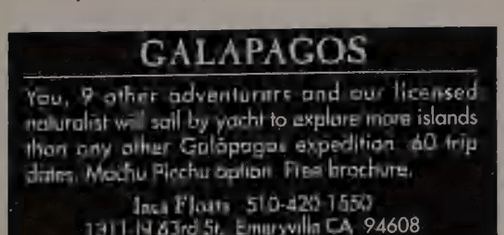
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By Robb Walsh

Pods of the Gods

By mid-July, there isn't much left in my garden. The brutal heat of a Texas summer burns up the tomato plants and shrivels the cucumber vines. The only survivors of the annual inferno are chili peppers and okra. Okra, in particular, seems to like the heat. The scraggly plants grow so tall that I sometimes need to climb on a chair to harvest the fuzzy pods before they get too big to eat.

In a 1974 survey by the United States Department of Agriculture, Americans named okra as one of the three vegetables they like least. I was never much of an okra fan myself. Raising a forkful of little green circles to my lips and watching the slime drip away from the fork was enough to convince me that I didn't really want to put them in my mouth.

Then I started eating at Dot's Place, a little restaurant in my hometown of Austin, where aficionados of southern cooking meet for lunch. The owner, Dot Hewitt, is one of the foremost practitioners of black southern cooking in the state of Texas, and okra is one of the best dishes in her lunchroom.

A few years ago, a California food writer asked me to help her find some great African American cooks to contribute to a cookbook she was writing. I introduced her to Dot, and she asked for Dot's okra recipe. Dot's cooking method is deceptively simple: you stew whole okra pods in tomato sauce. By keeping the pods whole, you all but eliminate the slime. When the book came out, I was distressed to find that the author had called for sliced okra in the dish, effectively ruining Dot's recipe.

While everyone complains about the slime that okra pods produce when sliced and cooked, the mucilage is actually very useful. For one thing, it is good for thickening gumbo. It also has medicinal uses. The mucilage is soothing to the digestive tract, and a preparation made from it was once administered to ulcer patients. Also, a gummy extract is used to make an extender for blood plasma.

Tim Gibbon; Envision

A vendor hawks okra pods at an open market in Bridgetown, Barbados.

Grant Heilman

Bob Gibbons; Photo Researchers, Inc.

A flower tops a tall stalk of okra, left. Below: An okra plant, showing typical finger-shaped pods.

The okra plant, *Hibiscus esculentus,* is a member of the mallow family (Malvaceae), which includes such well-known plants as cotton, hollyhocks, and the many wildflower species known as mallows. While it is found in Asia, okra is most closely identified with Africa, where the plant has long been a vegetable staple. Its tapered, finger-shaped pods may grow as long as nine inches, but at that length they are fibrous and tough. Immature pods of two to five inches are the most tender and tasty. Picking the immature pods also stimulates the plant to bear more abundantly.

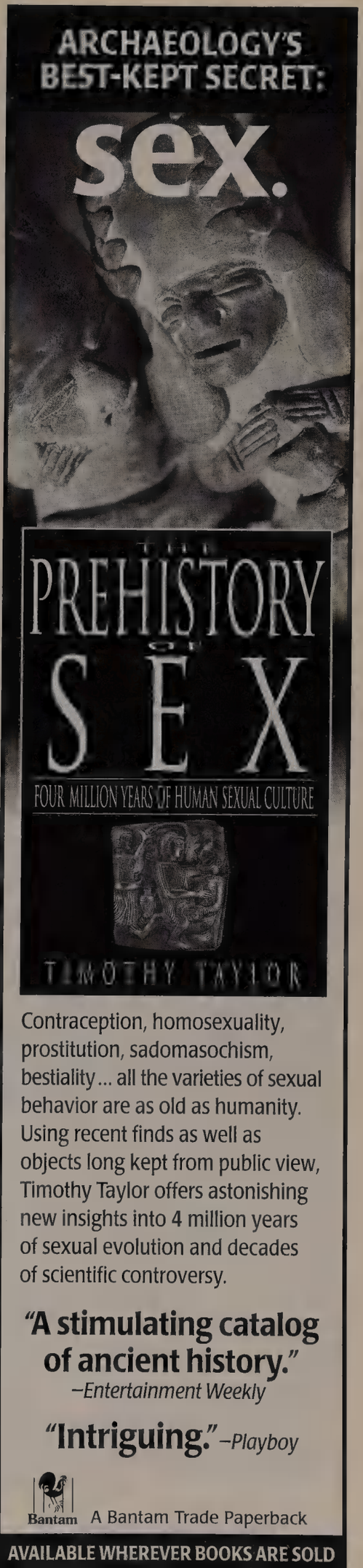
Every cookbook I've ever read on the subject claims that okra was brought to the New World by enslaved Africans. The plant's popularity in the American South, the Caribbean, and the state of Bahia, in Brazil—all areas where large numbers of slaves once lived—seems to support this conclusion.

According to the food authority Waverley Root, the word *okra* came from the Twi word *nkruman,* or *nkrumun.* In Umbundu, okra is called *ngombo,* from which the English word *gumbo* is derived. Food writers have long been obsessed with the connection between *ngombo* and the Louisiana stew called gumbo. Some speculate that a gumbo without okra isn't really gumbo. In truth, many gumbo recipes don't include okra and may better reflect the dish's historical origins.

The Louisiana dish we now call gumbo was invented by Native Americans, who thickened the catch-all stew with powdered sassafras leaves, also known as filé powder (as in the song lyric "jambalaya, crawfish pie, and a filé gumbo"). While the stew is now known throughout the country as gumbo (implying an African origin), Root observed that many traditionalists in Louisiana (who probably didn't know they were being traditionalists) preferred to thicken their gumbo with filé, the Native American method. On the subject of how *ngombo* got to Louisiana in the first place, Root wrote, "Okra was introduced into the Western Hemisphere by black slaves from Africa."

One sticky summer morning, strolling barefoot through the okra patch that used to be my garden, I picked a few pods and started wondering about these accounts of okra's survival in the New World. I split an okra pod open with my thumbnail and squirted a few seeds into my palm. According to the cookbooks, captive Africans secreted okra seeds in their hair or inside their ears during the long journey to America. Since the okra seeds in my palm were about the size of BBs, the idea of having a few rattling around in my ear made me wince.

Although it was not yet eight o'clock in the morning, it was already ninety degrees, and the cicadas had begun their shrill, day-long choir practice. As I



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walked back to the kitchen with my okra pods, I tried to imagine myself a captive West African being led away in irons by men with whips and guns. How would I react? Seething with anger, weeping with sorrow, and screaming in rebellion all came to mind. Sticking some okra seeds in my hair or ear did not.

"I've never met a scholar who believed that the slaves really brought seeds with them to the New World. The notoriously brutal conditions imposed during capture, transportation, and sale largely rule this out," Robert Voeks, associate professor of geography at California State University at Fullerton, told me on the phone. "These legends about slaves bringing okra seeds to the New World come from candomblé folklore."

Candomblé, a religion most widely practiced in the Brazilian state of Bahia, came to the Americas with the Yoruba people of West Africa. In Bahia, candomblé has long coexisted with Catholicism in a complex system in which nature spirits are syncretized with Catholic saints. The beliefs and rituals of candomblé are very similar to those of the Santeriá religion of the Caribbean and other African religions that survived transplantation to the New World.

During his fieldwork in Bahia, Voeks was initiated into a candomblé *terreiro,* or "holy house," where he learned more about the religion's use of ritual and medicinal herbs. In his forthcoming book, *Sacred Leaves of Candomblé* (University of Texas Press), Voeks describes the practices of candomblé herbalists, priests, and priestesses, who use some 200 different kinds of plants, including foods like okra, black-eyed peas, and yams.

Each of their nature spirits, or orishas, has a unique personality and favorite food. Shango, the orisha of thunder, is a womanizer and fond of goat. Yansan, the wind spirit, likes black-eyed pea fritters, or *acarajé;* Oshun, the spirit of fresh water, likes *xin-xin de galinha,* chicken cooked in palm oil with peanuts and dried shrimp. On an orisha's feast day, adherents of candomblé prepare the god's favorite food.

Carurú, an okra stew, is the food of the Ibeji, the twin gods of procreation and reproduction. The festival of these spirits is also called *carurú,* and for this event, the dish must be prepared according to a ritualized recipe. Deviation from the precise order of preparation is considered a sacrilege. *Carurú* may be the food of the candomblé gods, but Voeks doesn't recommend it. "It tastes like slime with seeds in it," he told me. "It isn't my favorite dish, but most people in Bahia love it."

But if the slaves didn't bring the favored foods of the candomblé gods to the New World, then who did? Voeks has done a lot of detective work on the mys-

Dot Hewitt's Stewed Okra

Don't cut or boil the okra. Just rinse off the pods and stew them in tomato sauce. If you give this recipe a chance, it will change your mind about okra.

G. Büttner/Naturbild/Okapia; Photo Researchers, Inc.

2 tablespoons vegetable oil or bacon drippings
1 yellow onion, halved and sliced
½ pound okra, rinsed
1 large can (14 ounces) whole tomatoes with their juice
1 teaspoon salt
1 teaspoon pepper
1 tablespoon sugar

Combine the onion, salt, pepper, tomatoes, and juice in a heavy saucepan. Crush the tomatoes using your hands and then add the whole okra pods. Cover and cook over low to medium heat until the pods are tender (about 25 minutes). Reduce heat, add oil or bacon drippings and sugar, stir, and serve.

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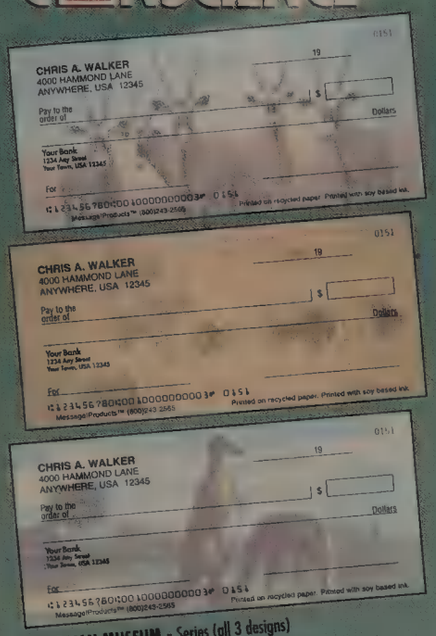

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tery of how West African medicinal herbs and native plants important to candomblé came to be transplanted to the New World. He has shown that in some cases, freed slaves actually returned to Africa and shipped the missing magical ingredients back to Brazil. But in the case of okra, yams, and black-eyed peas, he thinks there is a much simpler explanation. "There is no documentation, but the logical conclusion is that the Portuguese brought them over," Voeks says.

The African slaves were given garden plots to grow their own food, and slave owners made an effort to bring in foods that slaves already knew how to grow. We know that the Portuguese imported the African oil palm to Brazil so the slaves could have their familiar cooking oil: the red oil known as *dendê*. "The Portuguese knew it made good business sense to keep the slaves healthy," Voeks said. "Okra is a native of West Africa, it's nutritious, and it grows like a weed."

Okra is a fair to good source of calcium, potassium, vitamin A, and vitamin C. It also supplies about seven grams of protein per 100 calories. It is very filling and is especially popular in the Tropics, where it thrives during the heat of the summer when other vegetables wither.

Having dismissed the legend of slaves bringing okra seeds to the New World in their ears, I am left to ponder how such a dubious explanation became so universally accepted. I suspect that like many religious myths, the stories caught on because they hint at a larger truth.

Okra was a sacred food for some West African peoples, and thanks to Yoruba slaves and their descendants, okra is now a sacred food in Brazil and an important part of Caribbean and African American cuisine. Even if they didn't physically carry okra seeds with them, there is no doubt that enslaved Africans deserve the credit for spreading the pods of the candomblé gods all over the New World.

Culinary adventurer Robb Walsh received the 1996 James Beard journalism award for his writings about food.

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Zero Tolerance

When making scale models of the universe, be prepared to think exponentially.

By Neil de Grasse Tyson

It's tempting to speculate, as early philosophers once did, that our universe is simply an atom in a much larger mega-universe. Or that our atoms are entire star systems complete with planets and, possibly, life. Always at the fringe, the notion of nested microscopic universes was put to rest with the discovery of quantum mechanics. No relation to auto mechanics, quantum mechanics taught us that a completely different and unfamiliar set of physical rules applies to matter on the smallest scales. Likewise, the discovery of general relativity and the expanding universe painted a large-scale picture of the universe that could not have been deduced from the physical laws that describe our galaxy.

The observable universe is about as many powers of ten larger than droplets of mist as droplets of mist are larger than the smallest conceivable dimension. I don't know if the size of mist droplets is named after anybody, but the size of the universe (about fifteen billion light-years) is known as a Hubble length and is named, of course, in honor of the American astronomer Edwin Hubble, who discovered the expanding universe in 1929. The smallest conceivable dimension (0.00000000000000000000000000000016 centimeters) is known as the Planck length, in honor of the German physicist Max Planck, who presented a research paper in 1900 to the German Physical Society, introducing the idea that energy is emitted from atoms in indivisible units called quanta. At the Planck length, general relativity collides with quantum mechanics, the fabric of space and time becomes indivisible, and our ability to describe nature using our current laws of physics breaks down completely.

Credit the nearly simultaneous inventions of the microscope (in 1590) and the telescope (in 1608) and with allowing us to successfully shove back the boundaries of our ignorance in two directions. At the time, the farthest object for which a distance had been estimated was the planet Saturn. The stars of the nighttime sky were known to be farther, but no reliable estimate had been made. The smallest dimensions were limited by the human eye's ability to resolve an image: we might take that limit to be, coincidentally, the size of a single droplet of mist. Nowadays our vision spans from the observable universe down to the theoretical limits of particle physics—sixty-one powers of ten.

Our power-of-ten journey up and down the universe has been taken before. The Bible contains one of the first comparisons of scale in the passage "It is easier for a camel to go through the eye of a needle, than . . . ." Somewhat later, an exposition on the subject appears in the correspondence between Henry Norris Russell, the noted Princeton astrophysicist (then of Yale University), and Henry Fairfield Osborn, director of the American Museum of Natural History. In a letter dated 1915, Russell lays out his ideas and recommendations for a new astronomy exhibit:

> *Dear Professor Osborn;*
> *Your friendly interest in some of the ideas I spoke of the other day leads me to send you a sketch of my ideas for a series of models or diagrams on progressively smaller scales, to illustrate astronomical distances and the like. The enclosed scheme is tentative, but might serve as a basis for consideration. It suggests the construction of a set of diagrams and models, each on 1/100th the scale of the last.*

Russell goes on to suggest a sequence of cosmic curios for the exhibit hall, including a map of the Arctic and Antarctic (scale 1:1,000,000) and a "model or drawing of [the] Solar System," (scale 1:1,000,000,000,000,000) "with some cometary orbits. Radius of orbit of Earth 1.5 mm, of Neptune 4.5 cm." Note that in 1915, the polar regions of Earth had only recently been reliably charted and Pluto had not yet been discovered,

For the exhibition's final step (scale 1: 100,000,000,000,000,000,000), Russell recommends,

> *Diagrams or model showing the distribution in space of the Cepheid variable [stars] . . . and the eclipsing variable [stars]. These are distributed through a roughly flat layer about 1,000 light years thick (10 cm, on the model) with scattered ones beyond. In the galactic plane they extend in all directions at least five times as far.*

The idea that the spiral fuzzy things in the sky were entire galaxies external to our own Milky Way would not be confirmed for another ten years. Still, Russell foresaw a much, much larger universe than the available data permitted.

This is as far as it is possible to estimate distances at present, and probably gets into the Milky Way, though not through it. The visible stars and planetary and irregular nebulae lie within this region. The spiral nebulae are probably more remote. . . . Our descendants some day ought to be able to create a model in which the entire Milky Way has shrunk to a spot a few centimeters in diameter.

Further tempted by his scaling model idea, Russell cannot contain himself as he reverses the exercise and approaches the smallest known atomic structures—at a time when the atomic nucleus was not yet fully understood. Atomic nuclei were still being probed by the Cambridge physicist Ernest Rutherford (he would later name the positively charged particles "protons"), and the chargeless neutron would not be discovered until 1932.

Though it is outside my field, I can hardly refrain from adding the suggestion of extending the set of diagrams in the other direction. A magnification of 100 and of 10,000 times would come in the field of microscopy. 1,000,000 times would perhaps do for ultra-microscopic particles. 100,000,000 times would illustrate molecular diameters and crystal structure. 10,000,000,000 times would perhaps illustrate Rutherford's nucleus atom. But this is not astronomy—nevertheless I would like to see the whole set of models, illustrating what Johnstone Stoney, in a very striking paper, once called "the scale of that part of the operations of Nature which is accessible to our investigation."

Subsequent efforts to convey the scale of the universe include the charming 1957 hand-illustrated book *Cosmic View: The Universe in 40 Jumps,* by Kees Boeke, a Dutch schoolmaster. The 1978 short educational film *Powers of Ten,* which was subtitled *A Film Dealing With the Relative Sizes of Things in the Universe and the Effect of Adding Another Zero,* accomplished the same task with the innovative special effects of the noted industrial designers Charles and Ray Eames. Most recently, the film *Cosmic Voyage,* produced in the oversized, high-resolution, IMAX format, continues the scaling tradition with a journey through the dimensions of space (and time), informed by the very latest astronomical and subatomic discoveries.

We have come a long way from picturing a camel passing through the eye of a needle. But on the chance that you really did want to accomplish this task, consider that camel and eye are separated in size by four powers of ten. Assuming a needle's eye to be about one millimeter across, our first factor-of-ten jump takes us to one centimeter. A second jump takes us to ten centimeters. A third jump takes us to a meter. And a fourth jump to ten meters, ample enough for your average camel.

Power-of-ten arguments can illuminate disputes in unexpected ways. For example, recent attacks on Pluto's planetary honor have led to a suggested downgrade of its status to a planetesimal—a depressing thought for Pluto fans. But consider that Jupiter is eleven times the diameter of Earth, and Earth is only five and a half times the diameter of Pluto. Jovian life forms, if they exist, could justifiably declare all solid planets (Mercury, Venus, Earth, Mars, Pluto) to be solar system debris, along with comets and asteroids. In my opinion, we should accept Pluto as a bona fide planet, lest we downgrade ourselves as well.

Descending deep into a droplet of rain mist by five powers of ten takes us to 10^{-9} meters—a billionth of a meter—better known as a nanometer. We have sailed past all microscopic forms of life and the outsized DNA molecule. We have come face to face with the smallest molecules. Gravity goes unnoticed here, because the electrical forces that induce particles to repel or attract each other are thirty-seven powers of ten stronger.

Fortunately, matter typically comes with a well-mixed and equal number of positive and negative charges that cancel each other; otherwise life's daily activities might be severely challenged. For example, if all the electrons in a cubic inch

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from the tip of NASA's space shuttle were removed, leaving behind their proton counterparts, and if this tiny bunch of electrons were placed at the base of the shuttle's launch pad, then the attraction between these electrons and the protons would be stronger than the full thrust of the space shuttle's engines, and the craft would be unable to lift into orbit.

Another five powers of ten brings us to 10^{-14} meters (ten femtometers). With this step, we have not only entered the atom but we have also penetrated all regions where we are most likely to find electrons. We greet the atomic nucleus—home of protons and neutrons. Human understanding of what goes on inside the atom flowed from the discovery of quantum mechanics, which, for example, placed fundamental limits on the ability to measure both where a particle is in space and where it is headed. Better known as the Heisenberg uncertainty principle, this finding was fundamental to quantum mechanics and continues to remind us that we have opened a door to another world, where unfamiliar laws of physics reign.

Another five powers of ten takes us to 10^{-19} meters (or 100 zeptometers—no, I did not make that one up), which is deep within the structure of our protons and neutrons. We have known since the 1960s that nuclear and other select particles are constructed from more fundamental particles called quarks. But what are quarks made of? Nobody knows. And whatever they are made of, if anything, what are *their* constituents made of? We have exceeded the inner bounds of experiment, but we have not yet reached our perimeter of prediction. That moment arrives only after a journey of another sixteen powers of ten. At about 10^{-35} meters, we reach the Planck length, which takes a beam of light about 10^{-44} seconds to traverse. Call it the Planck time. Since shorter distances have no theoretical meaning, smaller units of time have no meaning either, which is what led to the conclusion that both space and time may themselves be quantized.

Returning to the scale of a droplet of mist, and rising up out of it, a mere five powers of ten takes us to about 100 meters, which comfortably contains the largest creatures that have ever lived on Earth. Another five powers of ten gets you to 10 million meters, which was declared by the French in 1790s to be the distance along Earth's surface from the North Pole to the equator (passing through Paris), thus defining the length of the meter for the first time. If you are curious, the meter was shortly thereafter defined more conveniently to be the separation between two scratches on a specially constructed platinum–iridium bar. Much later, in the 1960s, the meter was unromantically defined to be 1,650,763.73 wavelengths of an orange-red spectral feature in the gaseous element krypton. More recently, however, the meter was permanently defined to be the distance that a beam of light travels in a vacuum during 1/299792458 second.

It is theoretically possible that we share a mega-universe with other galaxies about which we know nothing.

Another five powers of ten gets you to a trillion meters (more than 600 million miles), a span that when measured from the Sun would comfortably enclose the entire orbit of Jupiter. Another five powers of ten takes you to ten light-years (ten times the distance that light, moving at the breakneck speed of 299,792,458 meters per second, travels in one year). This would get you past Alpha Centauri (which, at 4.3 light-years, is the star system closest to the Sun), as well as to a few other nearby stars.

The fastest craft ever sent to the stars is the *Voyager 2* space probe, which, in 1998, is scheduled to pass beyond Pluto's average distance from the Sun. It's zipping along at more than 30,000 miles per hour (nearly ten miles per second). At that rate, it will cross the ten-light-year sphere in two billion hours—about 225,000 years. You guessed it—science-fiction-style space travel is hopeless.

The next five powers of ten take you a million light-years away, half the distance to the Andromeda galaxy, the nearest spiral neighbor of the Milky Way. If both were shrunk to fit in opposite corners of a typical museum display hall, then our galaxy's entire solar system would fit within one of the atoms that compose the head of a pin.

Another jump of five powers of ten takes us too far. We have traveled ten times farther than the observable universe, exceeding the limit of our vision. In an expanding universe, we see ourselves as centered within a horizon from which light has been traveling since the beginning of time. If the universe is infinite or just very, very large, then it extends far beyond our own horizon. The horizon for other galaxies might overlap ours or be completely separate.

Likewise, a ship at sea is always centered within its own horizon, which may or may not overlap with the horizons of other ships—yet all ships sail the same ocean. It's therefore possible that we share a mega-universe with other galaxies about which we know nothing. A humbling thought for us all, but we've been there before.

Allow me to update Russell's visionary remark of 1915: Our descendants someday ought to be able to create a model in which the horizon of our *universe* has shrunk to a spot a few centimeters in diameter. Until then, consider that if the Milky Way and Andromeda were shrunk to fit within a single droplet of mist, then the observable universe would be the size (but we presume not the shape) of our famous biblical camel.

Neil de Grasse Tyson, an astrophysicist, is the Frederick P. Rose Director of New York City's Hayden Planetarium and is a visiting research scientist at Princeton University.

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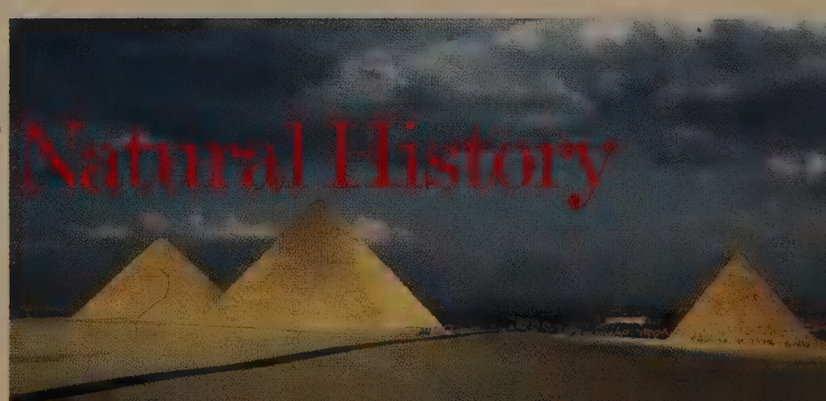
(800) 462–8687 or (212) 769–5700
Monday–Friday 9am–5pm Eastern Time



Sand Trapped

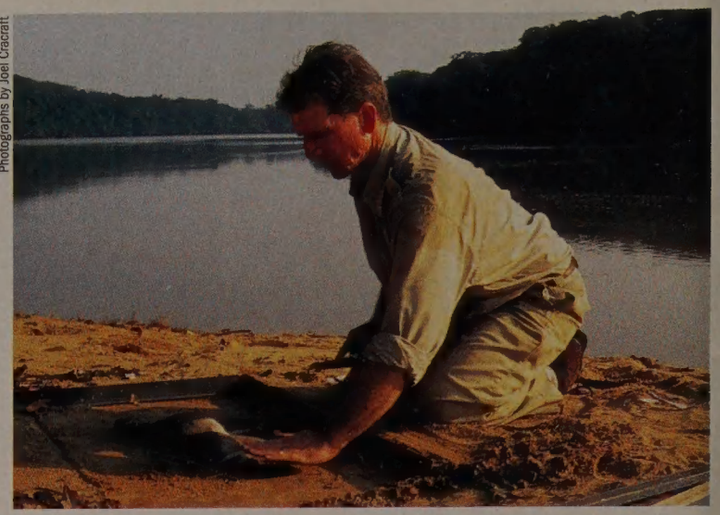
Photographs by **Alain Dragesco-Joffé**

A desert within a desert, the Ténéré is a cold-Saharan expanse of shifting dunes in northern Niger. The unstable sand, punctuated sparingly by rocks, tufts of grass, or on its more hospitable edges by small bushes, is home to die-hard desert dwellers. The Toubou nomads who traverse the Ténéré are among the few to witness the little life-and-death dramas played out by the creatures of the sand.

Photographer Alain Dragesco-Joffé had spent thirteen years in the Sahara, and more than two traveling through its heart with nomad guides, before he set eyes on a sand cat. With big ears set low on its head, this sand-colored solitary hunter, softly shod with long hair on its soles, is five pounds of pure stealth. The nomads say that vipers are one of its favorite prey.

During this confrontation of a sand cat and an Avicenna's viper, also known as the common sand viper, the hunter was so intent that Dragesco-Joffé was able to approach and document the scene. As he relates it, "The cat played a game of attack and dodge. While the snake lunged forward, fangs out, the cat managed to stun it with six or seven cuffs to the skull, forcing the viper to lower its head. The cat then suddenly flattened the head to the sand with a skillful blow, proceeded to crush the reptile's neck with a sharp bite, and immediately ate the head whole. Within ten minutes the entire sixteen inches of viper, ending with its little black tail, had been devoured." — *Judy Rice*

Out of Africa



Photographs by Joel Cracraft

Expedition member Steve Quinn, above, makes a mold of a duiker. Below: Forest elephants dig in the mud for mineral salts.

"Dzanga-Ndoki Rainforest: The Making of an Exhibition," will be in the Akeley Gallery through September, 1997

In November 1996, the American Museum of Natural History sent an expedition to the Central African Republic's Dzanga-Ndoki rain forest to collect materials for a diorama that will be the centerpiece of the Museum's new Hall of Life's Diversity. The team of twenty was made up of scientists from the departments of ornithology and mammalogy, as well as exhibition preparators and designers, and audiovisual technicians.

More than seventy-five photographs documenting the expedition's first crucial field phase in creating the rain forest replica will be on display in the Akeley Gallery through September 1997. "Dzanga-Ndoki Rainforest: The Making of an Exhibition" shows the team members collecting plants and animals; making molds and casts of tree trunks, leaves, and termite nests; filming forest elephants digging in the mud at a marshy clearing, or "bai"; and conducting interviews with the BaAka Pygmies and other peoples native to the forest.

The Museum chose to represent Dzanga-Ndoki, a rain forest with only about sixty inches of rainfall a year, because of its tremendous species diversity. Scientists working there have so far identified about 100 species of mammals, 300 of birds, hundreds of trees, and thousands of ants, termites, beetles, and butterflies. When the new hall opens in the spring of 1998, the 2,500-square-foot, multimedia walk-through diorama—the world's largest—will depict this rich biome in unprecedented detail.

Events

July 6 and 9

On Friday, July 4, *Mars Pathfinder* will land on Mars, the first spacecraft to do so since 1976. On the following Sunday and Wednesday, between 2:00 and 4:00 P.M., the Museum will be the site of live, interactive television broadcasts focusing on the mission. Produced by Passport to Knowledge, these electronic field trips will allow Museum visitors to see the latest images from the surface of Mars and hear breaking news from NASA scientists involved in the mission.

Mars Pathfinder is the next step in the search for life elsewhere in the solar system and a test of new technologies for future missions to Mars. *Pathfinder* will also deploy *Sojourner* a twenty-three pound, solar-powered vehicle, the first rover to explore Mars.

For the week of July 6, the Museum has scheduled a number of workshops (for children ages ten and older) during the day, and evening lectures about the *Pathfinder* mission, Martian meteorites, and the search for life in the universe. For a complete schedule, call (212) 769-5200.

July 9

Geologist Sidney Horenstein, coordinator of the Museum's Environmental Programs, will lead an all-day trip to explore places of geological and historical interest in and around Hartford, Connecticut. The itinerary includes a cruise down the Connecticut River, as well as a visit to Dinosaur State Park, where 200-million-year-old fossilized dinosaur tracks were discovered in 1966. The expedition, which begins at 9:00 A.M. and returns at 7:00 P.M., is open to Family/Dual and Higher Members only. Call (212) 769-5606 for further details.

In July and August

A special exhibition, "The Lost World: The Life and Death of Dinosaurs," features recent dinosaur discoveries. The skull of *Giganotosaurus* and a seventy-foot-long replica of *Mamenchisaurus* are among the displays. The exhibition will be in the Hall of Ocean Life until September 30.

The Museum's IMAX Theater is featuring *Stormchasers, Cosmic Voyages,* and the laser-light animation show *Laserwarp.* Another show, *Laser U2 in 3-D,* will be shown only on Friday and Saturday evenings at 9:00 and 10:00 P.M.

The American Museum of Natural History is located at Central Park West and 79th Street in New York City. For tickets and information about events, call (212) 769-5200. Consult the Museum Web site for additional information (http://www.amnh.org). For hours and admission fees, call (212) 769-5100.

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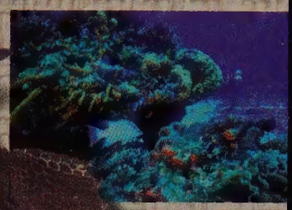

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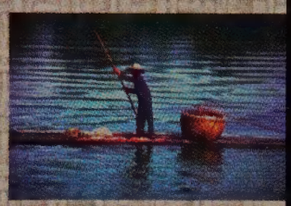

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(This is not an average washing machine.)

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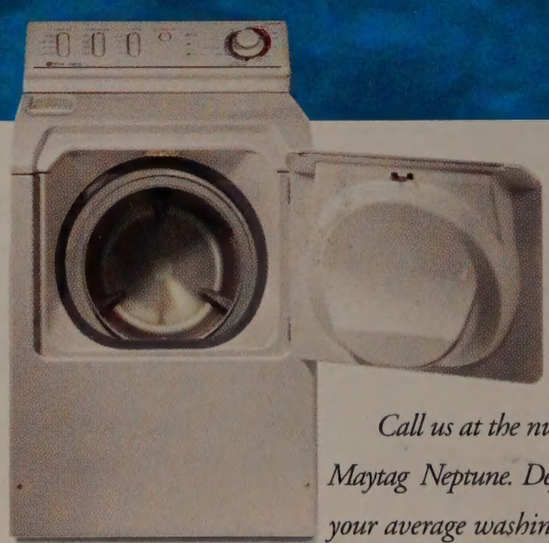

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